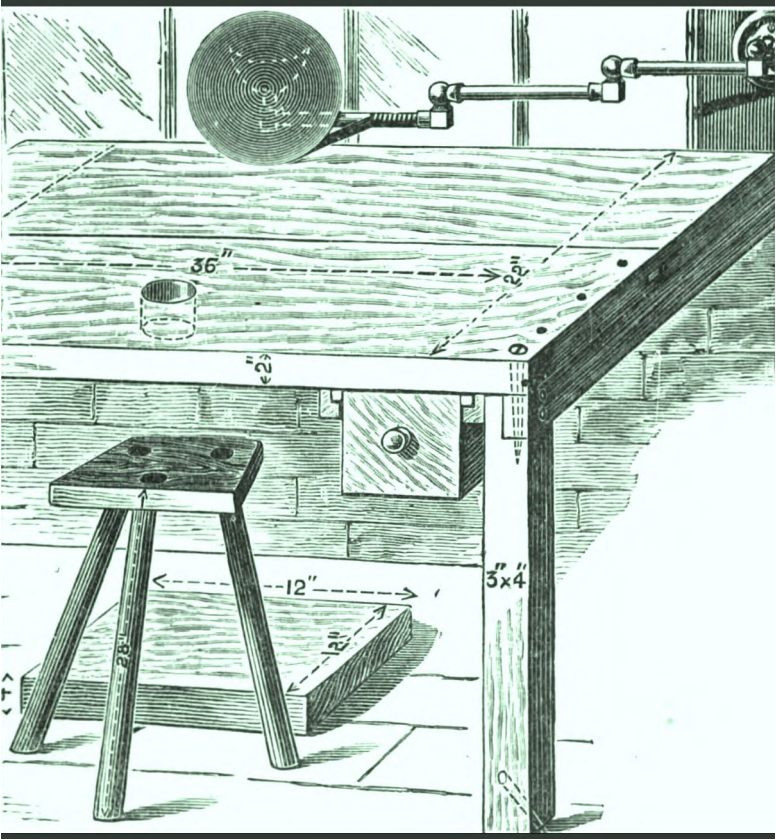

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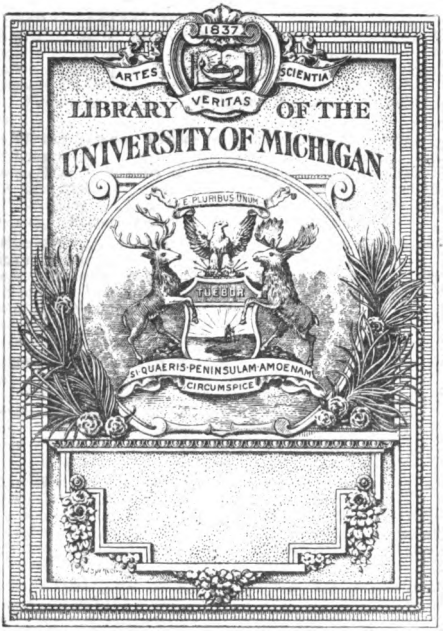

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ENGRAVING METALS

WITH NUMEROUS ENGRAVINGS AND DIAGRAMS

EDITED BY
PAUL N. HASLUCK
Author of "Handybooks for Handicrafts," etc. etc.

PHILADELPHIA
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PUBLISHERS' NOTE

THIS short treatise on Engraving Metals is issued in the confident belief that it is not only thoroughly practical and reliable, but is so simply worded that even inexperienced readers can understand it. Should anyone, however, encounter unexpected difficulty, he has only to address a question to the Editor of WORK, La Belle Sauvage, London, E.C., and his query will be answered in the columns of that journal.

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ENGRAVING METALS

CHAPTER I.

INTRODUCTION AND TERMS USED.

ENGRAVING is the act or art of producing figures and designs on metals and other substances by incision or corrosion. Work that is done by incision is distinguished as dry-point; that engraved by corrosion is particularised by the name of the special process by which it is effected, as etching, mezzotint, etc. Dry-point is engraved with gravers and similar small tools, which are made to cut by the force of the muscles of the hand; for large work small chisels, struck with a hammer, are employed also. Various acids, usually compounded, are used in the different corrodent processes.

The practice of engraving is comparatively clean and inexpensive, and its elementary principles are easily learned. Ordinarily diligent pupils can make such progress as to give them encouragement to greater efforts, and by assiduous practice can become expert engravers capable of earning their living by the practice of the art.

Engraving is a very ancient art. Engraving on stone and on signets is mentioned in the early part of the Old Testament. In Exodus, Moses is directed to take two onyx stones and grave on them the names of the children of Israel. "With the work of an engraver in stone, like the engravings of a signet, shalt thou engrave the two stones with the names of the children of Israel" (Ex. xxviii. 11). Job ex-

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claims: "Oh! that my words were graven with an iron pen and lead in the rock for ever" (Job xix. 25). The "iron pen and lead" are strongly suggestive of chiselling out the letters and filling in the channels with lead, a process frequently adopted for monumental engraving. The Egyptian hieroglyphics on monoliths and on the walls of the tombs are engraved. The tools, weapons, and ornaments of the ancient Egyptians were often elaborately engraved. Chasing, carving, and sculpture, which are allied arts, flourished amongst these people. When the Israelites went out of Egypt amongst them were many skilled in the art of engraving, as frequent allusions show.

The Greeks learned the art of engraving and chasing in metals; it was much practised and had considerably advanced in the time of Homer. Many specimens of Grecian engraving show the excellence to which the art had attained. The Etruscans, whose vases and other works of art are still unsurpassed for beauty of form, appear to have attained the highest degree of skill in chasing. The principal chasing and engraving of antiquity was done on armour and weapons, goblets, dishes, etc. The laws of Rome were engraved on brass plates. The ancient engraving was in some cases used for marking impressions in plastic material, as wax, clay, etc., in the same way that seals are now used.

The discovery of a method of printing from engraved plates was the means of advancing the art very rapidly. Engraved blocks of wood were first used by the Chinese. As early as 1,000 years B.C. a notice of printing is found in the Chinese annals. It is, however, not till the thirteenth century of the Christian era that any notice of the process in Europe is found. Gutenberg, who is said to be the first who adapted printing to a useful purpose, was born in 1400, and Caxton, the earliest English printer, died in 1492; and it was not till about this

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time that printing was generally practised. The art of engraving on wood flourished as printing became more extensively practised.

To trace the history and development of engraving on metal is beyond the scope of the present work. The subject is, however, full of interest to those who intend to pursue the study and practise the art. An instructive book is "Les Merveilles de la Gravure," and a few notes culled from it will be entertaining. Maso Finiguerra, a goldsmith, engraver, and niellist of Florence, is credited with having made the discovery of copperplate printing in 1452. The traditional legend is that Finiguerra had just put the finishing touch to an engraving of a Pax, and, wishing to see the effect of his work, he filled the lines traced by his graver with a liquid composed of oil and lampblack. By chance a pile of damp linen was placed upon the engraved plate thus prepared, and the lines filled with the black liquid were reproduced upon the linen.

Niello work was much in fashion in the fifteenth century, and the mode of taking proof impressions should have suggested copperplate printing. The engravers took proofs of their work by impressing clay, and would not fuse the indestructible "niello" until the engraving was perfected to satisfaction. In the course of time it was discovered that damp paper firmly pressed upon the engraved work, the lines of which had been previously filled with certain ink, showed a perfect imprint. This method of taking proofs on paper was adopted for a long time by niellists to see the progress of their engraving. Many of these impressions have been preserved, but those taken previous to the time of Finiguerra are evidently only proofs of inlayers' work. That the engravings were not made to print from is obvious from the fact that the figures are shown left-handed. Had they been intended to print from the figures would have been reversed so as to show right-

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handed. It appears singular that this common mode of taking proofs did not at once suggest the art of printing from engraved plates.

After Maso Finiguerra had thus unconsciously discovered a new application for engraving, and a knowledge of the discovery had spread, many artists to whom the process of chasing and engraving was familiar worked in the new field. Euclid was printed in 1482 with diagrams on copper, and an edition of Dante (1481) contains prints from engravings executed on metal which. though accurately drawn, were evidently engraved by an unpractised hand.

Andrea Montagna, born at Padua in 1415, was the first artist of note who engraved plates to be printed from. As a painter his fame became great, and his works are much admired. A wish to see his compositions widely spread was probably his chief motive for adopting and fostering the art of engraving. Montagna's prints ought, strictly speaking, to be considered the first engravings executed in Italy; until then the work had remained in the hands of the goldsmiths and metal-workers. Engravers kept pace with the general progress of art in Italy, but, after having produced works in which the feeling for colour and form is expressed with peculiar talent, they appear to have suddenly sunk into inactivity.

Albert Dürer, the German painter and engraver, rivalled goldsmiths in carving metal and artists in designing, whilst he excelled all in his knowledge of engraving. He drew figures and moulded outlines with inimitable skill. He worked with very fine gravers, and his engravings, executed in an infinite number of lines, necessitated slow and careful work. He excelled in every style; his landscapes, intersected and enlivened by rivers, and full of fortified castles and turreted houses, are engraved with a pleasing fineness of execution. Experts may dis-

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cover errors in his aërial perspective, but any inaccuracies in the relative proportion is in a great measure atoned for by the delicate finish of the distances. Dürer's engraved portraits show his great knowledge of physiognomy; his execution is always good, and his works are excellent models.

The capabilities of the etching needle appear to have been developed by Mazzuoli. Albert Dürer and many of his predecessors had used this process without much improving on it. Etching is, above all other, the kind of engraving best suited to a painter, and it will be easily learned by anyone with a knowledge of drawing. In tracing the design upon the ground the etching needle should not imitate the work of the graver. The process of etching enables the painter to promptly engrave his own conceptions, and dispense with the dangerous interposition of an interpreter. Mazzuoli had many pupils who successfully practised the art; one of these, Meldolla, worked in a style which is scarcely distinguishable from the master. The former, however, always used acid alone; the latter sometimes touched up his etching with dry-point tools.

William Hogarth, the English painter and engraver, claims a brief paragraph. He not only designed pictures, but engraved them, thus retaining their original style. He used the etching needle or the graver as readily as the brush, and his engravings not only possess all the good qualities of his pictures, but excel them in some points; his work is full of energy and character. His engravings were nearly completed by etching, and then skilfully touched up with dry-point tools. Hogarth was apprenticed to a goldsmith, and began life by chasing metal and engraving armorial bearings, figures, and arabesques on silver, gold, or bronze. Thus he acquired the manual skill of engraving with which he inaugurated a new style of art.

These few brief notes suffice for retrospection.

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The practical details of the art will receive attention in later chapters. It may here be mentioned that dry-point work includes all work done with gravers and similar tools, and comprises the engraving of inscriptions, monograms, armorial bearings, etc., on all metals. Copperplate engraving, used for printing visiting cards and similar purposes, is also comprehended. The work is precisely similar, but all that has to be printed from must be engraved reversed, so that the impression obtained from it reads correctly. Inscriptions, etc., that are to be read on the metal as engraved, of course, commence on the left-hand side; but for printing from they commence on the right-hand side, and the letters slope the wrong way. Although the reversed lettering appears more difficult to cut, yet such is not the case, because the engraver simply follows the drawing.

Artistic engraving involves an artistic taste, and a knowledge of drawing is decidedly beneficial. Mechanical engraving is, however, an art that needs only care and attention to the drawing of the artist. It is not suggested that drawing is altogether unnecessary in the practice of engraving, but nevertheless many excellent engravers are quite incompetent draughtsmen. Careful manipulation of the tool and the skill in using it, which is to be acquired by practice, will enable anyone to execute good engraving.

To the tyro in any kind of work probably nothing is more discouraging than to find his search for knowledge barred by terms which he cannot understand. The following, therefore, is a glossary of the terms used in the art of metal engraving, including the names of tools and processes employed.

Aquatint.—The process of effecting this style of engraving is briefly thus. A polished metal plate has resin spread over it in such a manner that countless interstices are left between the resinous particles. This superficial covering is called ground, and it may be made in two ways, by the dry process

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and by the solution process. The dry process consists in dusting the greased surface of a plate with powdered resin. By reversing the plate the superfluous powder is shaken off, and the particles that adhere are fixed by warming the plate sufficiently to partially melt them. The solution process consists in dissolving resin in alcohol and flooding the plate with it. The surplus liquid is run off, and innumerable cracks form in the film which adheres to the plate. Both of these processes leave between the resinous particles countless interstices, which are subsequently bitten in by acid. The size of the particles—that is to say, the coarseness or fineness of the ground—may be varied by using different materials. Burgundy pitch, mastic, frankincense, and other resins are available for the purpose. To etch in this ground a bank of wax is made around the plate and dilute acid is poured on it. As soon as the lightest tints are sufficiently bitten in, the plate is washed and dried. The portions that are to come out light in the print are stopped out with Brunswick black to protect them from any further action of the acid. Acid is again poured on, and its action again arrested as soon as the second tints are sufficiently deep; these are then stopped out, the operations being repeated till the darkest tints are finally attained. The above process describes only the groundwork of aquatint; the designs are traced in the ground prepared as above, and are etched in at the same time as the ground itself.

Banking.—This is an engravers' term signifying raising a bank of wax around a plate to form an embankment to hold acid used for biting in. A compound of beeswax, resin, and tallow is employed of such a consistency that it is easily moulded with the fingers. The bank is usually made about half an inch high.

Banknote Engraving.—Mechanical designs are used chiefly in producing banknotes as being less

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easy to counterfeit. The separate designs, forming a complete banknote, are engraved on steel dies, which are hardened and used only for impressing steel rollers. These rollers are then hardened and used in a clamming machine to impress the steel plates used for printing from. The plates are used soft, and when worn may be renewed by passing between the rollers. Geometrical patterns, cut by means of geometric chucks, are used for some of the American notes.

Biting in.—This is a process by which the metal is eaten away with acid. Plates to be bitten in are first protected by a coating of ground; the design is traced through this ground by some of the various methods described under their respective heads, leaving the metal exposed; a bank of wax is made around the plate, which is then flooded with acid. The acid attacks the exposed metal, dissolving it and making hollows. The depth of the biting in has to be in accordance with the depth of the tint to be printed. It is controlled by stopping out.

Bridge.—The appliance used by engravers to support the hand clear of the work is the bridge, which is usually a board resting on short feet, so as to span the plate being engraved.

Burins.—Burins are the tools commonly employed for engraving on metal, and better known as gravers, which see.

Burnishers.—These are tools used for smoothing surfaces, to obliterate lines, etc. Engravers' burnishers are made of steel, usually elliptical in cross-section, tapering and having a blunt end. Various sizes are used.

Cameo.—Engraving in relief is cameo, as opposed to intaglio. Stones and shells are used for cameo engraving; a peculiar feature required in the material is that it should have layers of different colours. Monochrome gems engraved in relief are not true cameos.

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Celature.—This refers to the act or art of engraving, chasing, or embossing metals in relief, and also to the articles so treated.

Chalcography.—The act or art of engraving on copper or brass is chalcography.

Chasing.—Chase is a contraction of enchase (which see). Parts of the metal are cut away or depressed, leaving protuberances of ornate form. Ordinary engraving is sometimes improperly called chasing.

Clamming machine.—This is used to transfer the reverse impression from a hardened steel roller to a soft steel plate to be used for printing from, as explained in banknote engraving. Copper rollers for calico printing are also indented by means of a clamming machine.

Copperplate engraving.—Plates of copper are operated upon in this process. The lines may be etched with acid or cut with a dry-point. In printing from copperplates the lines are filled with ink, the surface is wiped clean, and the plate passed through a press together with a sheet of paper or card. The ink in the lines adheres to the paper, forming a print in reverse. The plates require to be inked afresh for each impression.

Counter-proof.—This is a print made by transferring from one taken in the usual way, the object being to furnish the engraver with a proof of his work not reversed. To take a counter-proof, a proof that has been very recently printed is used.

Cradle.—This is a tool used for mezzotint engraving, described under Rocker.

Cycloidal engine.—The machine engraving of scrolls and geometric lines, which is used principally on banknotes, cheques, etc., is done with a cycloidal engine. The lines are generally cycloidal in form, being cut by a point tool fixed eccentric to the plate, which revolves beneath it. The plate may be made to move in a straight line, a waved line, an elliptical line, etc. The line engraved by these compound

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movements forms a complex figure of such absolute regularity as to render counterfeiting impossible except by the aid of a similar machine.

Dabber.—This is a ball of woollen material covered with silk, used for spreading the ground upon hot plates previous to etching. Also it is used for inking plates for taking rough proofs for the engraver's use.

Diamond-point.—This is an engraving tool, having a diamond set in the point, used for ruling fine lines in machine engraving. Similar tools are used for etching.

Die.—This is a hardened engraved plate or small roller of steel cut intaglio, used to impress the surface of soft steel rollers, which are afterwards hardened and used in a clamming machine. These rollers are in cameo, and are used for impressing plates for banknote printing, or copper rollers for calico printing.

Drawing-point.—This is a pointed tool used for drawing upon metal; called also a dry-point tool, to distinguish it from etching needles. The drawing-point is used to sketch the design on metal before engraving it, etching needles being used to scratch away the ground on the prepared plate.

Dry-point.—That process of engraving effected entirely with gravers and similar tools is so termed to distinguish it from the various other processes in which acid is used to deepen the lines, as in etching.

Ectypography.—This is a method of etching giving a design in relief, instead of incised, as usual. In this process the ground is removed from the plate between the lines instead of at the lines.

Electro-etching.—This is a process for biting in an engraving by immersing it in a bath and employing an electric current. When deep enough, the fine lines are stopped out; a second immersion deepens the then exposed parts, and makes the second tint, these operations being repeated to produce the necessary gradations.

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Enchasing.—This is a term popularly contracted to chasing, a form of engraving which results in an ornamental embossing. The metal may be punched up from the back or indented from the front, the work being finished with gravers. The methods of producing enchased work are variously combined, according to the object wrought and the taste and skill of the chaser.

Etching.—Drawings are etched by execution with a pointed tool upon a metal surface covered with a protective coating or ground and afterwards bitten in with acid. The ordinary procedure is to heat a polished plate and cover its surface with ground by means of a dabber. The design is drawn with an etching needle, which lays the plate bare at all the lines. A bank of wax is then made around the plate, and dilute acid poured on to it. The corrosive action of the acid on the bare metal is called biting in. When sufficient depth is attained for the lightest parts, the acid is run off and the surface of the plate washed. Those parts that are sufficiently bitten in are stopped out with Brunswick black. The plate is again flooded with acid and bitten in enough to produce the second tint; it is then again washed, the light parts are stopped out, and so on till the biting in of the darkest parts is effected. The bank of wax is removed, the plate cleaned, and it is then ready for printing from. Some etched plates are touched up with dry-point tools, but etching proper is effected only by the action of acid.

Etching Needles.—Tools used for scratching away the ground on plates prepared for etching are etching needles; their sizes vary according to the width of lines to be drawn. Ordinary sewing needles mounted in suitable handles answer the purpose.

Gravers.—Gravers are the edged tools used for engraving all metals, hard woods, and other materials. Gravers are made in steel of different shapes, hardened and tempered to suit the material

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they are intended to cut. Ordinary gravers are square or diamond-shaped in cross section, and are ground obliquely on the end, leaving one of the angles most prominent. The angle which forms the point is always used next the work, and is called the belly of the graver. The sectional form of the belly is frequently modified to suit peculiarities of work. Some gravers are curved lengthways to leave the belly prominent, so that the tool may act nearly horizontal to the surface of the work when the handle is raised. Gravers for stippling are curved the reverse way. Tint tools (which see) are a form of graver.

Ground.—The surfaces of plates that are to be etched are covered with a ground, an acid-resisting composition. Various compounds of asphaltum, Burgundy pitch, and white wax are usually employed. The plate is heated, and the ground spread over its surface with a dabber; the surface of the ground is then blackened by smoke so as to show more plainly the lines that are subsequently drawn through it. In mezzotint engraving the whole of the ground on the face of the plate is dotted by means of a rocker, sometimes called a grounding-tool, so that after biting in it will print a uniform tint. The lights are, however, produced before biting in by *coalescing* the *burrs* of ground. Soft ground, made by adding lard to ordinary ground, was formerly used for a peculiar kind of etching which is now superseded by lithography.

Intaglio.—Engraving that is incised is intaglio, as opposed to cameo. Seals and dies are engraved intaglio so that they produce a cameo impression.

Line Engraving.—Line engraving consists of incised lines cut with dry-point tools; it is generally conceded to be the highest style of the art. The term is used to distinguish from aquatint, mezzotint, stipple, etc. Line engraving is now used to supplement the above processes in high-class engraving.

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The plates are first bitten in, and afterwards certain parts are engraved with dry-point tools.

Mezzotint.—In this process the surface of the steel plate to be engraved is covered with an innumerable quantity of burrs by means of a rocker. The roughened surface thus prepared is burnished or scraped smooth to form the high lights, the burrs being obliterated partially or entirely according to the gradation of light required.

Niello.—In this process the engraved lines are filled with a black composition called niello. This style of ornamentation is very ancient, and is accredited with having accidentally caused the discovery of copperplate printing. The process is to draw the design on the metal and then cut in the lines with gravers. The niello, a black enamel-like composition, is laid on the engraving and melted, so that it flows into the lines. The surface is then scraped and burnished, and presents the appearance of a drawing in black. Brass and zinc door-plates, having the engraved parts filled with wax, are familiar examples of a process similar to niello.

Proof.—An impression taken for examination from an engraved plate is a proof. Proof engravings, or more properly prints, are impressions of finished plates taken before the ordinary edition is printed.

Re-biting.—This is a process of deepening the lines in engraved plates. The plate is first cleaned perfectly; ground is then laid on with a dabber to cover the surface only, care being taken not to clog the lines. A bank of wax is then made around the plate, and acid is poured on as described in biting in. As each portion of the engraving is bitten in sufficiently, it is stopped out so as to obtain a gradation in the tints. The process of re-biting is used to deepen the lines in plates that have been worn in use.

Reversing.—This is a process of obliterating engraved lines by means of blows from a bare hammer on the face of the plate, the back of which rests upon

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a sheet of lead supported on an anvil. The resistance of the lead causes the metal below the incised parts to rise level with the surface, filling the grooves. The back of the plate shows corresponding depressions.

Rocker.—This is a tool used for mezzotint engraving, consisting of a steel plate attached to a handle. The plate has angular grooves in its under side, so that by grinding the edge obliquely across the sides a row of points appears at the end, this being rounded off towards the corners. The tool is rocked in a zigzag course across the plate, the points raising a multitude of burrs. The first series of burrs is crossed at right angles and then obliquely till the entire plate is roughened and thus made to hold ink. The design is made by removing the burrs in parts according to the gradation of light required. The burrs are removed by burnishers and scrapers.

Roulettes.—These tools impress a series of dots, chiefly to make lines for mezzotint engraving. A steel wheel is mounted to revolve freely on a central axis; the periphery of the wheel is cut in relief to one of many patterns. This wheel, rolled on a plate, will leave a track of indentations corresponding to the periphery of the wheel.

Ruling Machine.—This is used for the purpose of making parallel lines through the ground on a prepared plate. In line engravings, monotones, still water, the sky, etc., are often ruled with a machine. The distance between the lines may be constant, or increase or decrease gradually if the machine is so arranged. For shading mechanical drawings machine ruling is very effective.

Scraper.—For scraping surfaces is used a tool which usually is a triangular bar ground sharp on the angles and pointed at one end, the other being fixed in a handle.

Steel-plate Engraving.—This process resembles copper-plate engraving, steel being operated upon.

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Stipple.—In stipple engraving the effect is produced solely by dots. These are made closer, deeper, and larger according to the depth of the tint required. They are made in the ground of a plate, and bitten in; afterwards they may be modified and perfected with the stippling graver, which has a concave belly, so as to present the tool more vertically to the face of the plate than for line engraving.

Stopping Out.—Covering any portion of an etched plate with a composition impervious to acid is "stopping out." When the lightest tints have been bitten in sufficiently they are stopped out with Brunswick black. The remaining portions are deepened by repeating the biting in till a second tint is attained; the parts are then stopped out. Each process of stopping out and biting in gives a distinct tint.

Tint Tool.—This is a graver for cutting lines forming tints. The tools are of various sizes to cut lines of various widths, according to the depth of the tint required. Tint tools effect by hand the work of the ruling machine.

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CHAPTER II.

ENGRAVERS' TOOLS AND THEIR USES.

TOOLS for engraving metals by incision are but few in number, and an outfit sufficiently complete for a beginner will cost less than two sovereigns, the cost of bench being excluded. For less than one sovereign even can be obtained the really essential tools with which a small start may be made.

The engraver's outfit includes: 3 sandbags or cushions, different sizes; 1 best Arkansas oilstone; 1 dozen Stubbs's square gravers; 1 dozen graver handles; 1 tracing or etching point (steel, with ebony handle); 1 oil can; 1 burnisher (steel, with curved end, handled); 1 scraper; ½ dozen shading gravers, D threads (handled), numbers 2, 4, 6, 8, 10, and 12 widths; ½ dozen plain flat gravers of the above widths; 1 pair spring dividers; cement block, cement, oil, turpentine, pencil, indiarubber, and pounce bag; practice plate (German silver, buffed or polished ready for work, about 1 lb.).

The outfit for engraving brass and zinc name-plates, etc., will include: 3 diesinker's chisels for outlining and sinking letters; 1 pair 12-in. compasses (steel points); 1 pair large spring dividers; 1 T-square, straight-edge, and rule combined; 1 sandbag, 12 in. in diameter when filled; 1 hammer (handled); 1 flagstone about 14 in. by 14 in. by 2 in.; 6 lb. of cement; zinc plate for practice; pumice-stone, water of Ayr stone, crocus, and lamp-black for polishing; Archimedean stock and drills; files; bench vice.

These tools must be of the very best quality, and capable of cutting anything between Britannia metal

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and moderately hard steel. If the expense of the above outfit is too great, fewer tools may be bought at first, the engraver using personal judgment as to what may be dispensed with best.

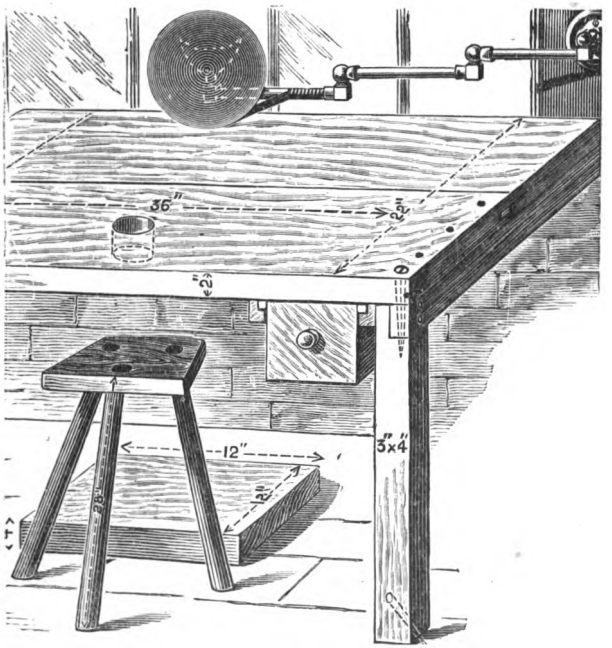

Fig. 1.—Engraver's Bench and Stool.

Of the first importance in the practice of engraving is a good, strong bench (Fig. 1), sufficiently high to stand at when large work—such as a tray, dish-cover, or brass name-plate—is being done. The bench should be in a good light, and for night work should be fixed under a gas bracket which has two or three joints. When engaged on smaller work the engraver may sit upon a high stool with his feet resting

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on a box; this box, also, may be stood upon so as to increase the available height of the engraver when using the block (Fig. 2) for large hollow ware. This block is fixed, when required, in the hole shown near the edge of the bench, and secured by the wooden nut shown by Fig. 3. The block is turned out of beech or elm, and has a slight hollow turned in the top, in which to place a sandbag, and on which the inside of the dish-cover rests. The engraver by this means gets a firm hold of the cover, is enabled to turn it in any direction, and avoids scratching or

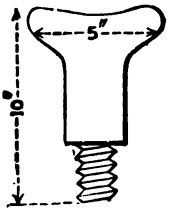

Fig. 2.

Fig. 3.

Fig. 2.—Bench Block; Fig. 3.—Nut for Bench Block.

bending the side opposite to which he is working. For ordinary home work the bench may be a table, which must stand steadily without rocking; and, instead of the stool, an ordinary house chair may be used.

The direction of a clear and steady light upon the work being engraved is most important, and it is generally conceded that a northern aspect affords a clearer and steadier light than any other. When working by artificial light a condenser must be used to concentrate the rays. Shades and screens for protecting the eyes from glare are adjusted according to the exigencies of the workplace. It is important that the light falls on the work, and that the eyes are shaded.

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The oilstones used for sharpening engravers' tools, as a rule, are of but two kinds—namely, Turkey and Arkansas; the former is a soft and the latter a fine and hard stone. The Turkey hone is cheap and is good in its way, but needs constantly re-facing or levelling up, whilst the Arkansas stone, though costing some shillings more, will last for years without requiring to be levelled. An Arkansas stone, 5½ in. by 2 in. by 1 in., will cost about 12s. 6d., but if set in a wooden block, and used carefully, will last a lifetime; it will not rub into holes as does a Turkey hone, and it gives a fine polish to the facets of the graver, which produces a brilliant cut when polished with jeweller's rouge applied with a leather.

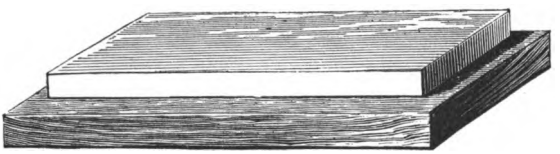

Fig. 4.—Oilstone in Wooden Block.

In choosing an Arkansas stone, endeavour to see the whole of the stock of the dealer, and ascertain which are the hardest and which the softer stones. Choose a stone which is quite white, without cracks or yellow veins, and of the second degree of hardness. The stone should be mounted on a mahogany block (Fig. 4), inlaying it to the depth of ½ in., so that a gentle tap of the mallet will fix it. A new stone will not cut very readily, and to make it "bite" scrub it well on the face with a piece of gas-coke and plenty of oil, which will remove a gummy substance often formed on stones when they have been long in stock. The new stone will soak up a large quantity of oil on first being used. Do not forget to clean the stone occasionally, paraffin oil being an excellent cleanser. The best oil for use with the stone is neatsfoot.

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which should be kept handy in an oil-can; that shown by Fig. 5 is suitable.

Amongst the gold engravers of Clerkenwell a small piece of a dark variety of the mineral schist or jasper, known in the trade as "blackstone," is used for polishing the angles of gravers after these have been whetted. This stone is identical with the "touchstone" of the gold and silver assayers, and may be obtained at the Clerkenwell tool-shops. The blackstone is drawn lightly over the apex of each of the two whetted angles of the graver, the effect being to remove the burr without lessening the

Fig. 5.

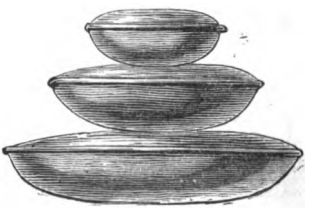

Fig. 6.

Fig. 5.—Oil-can; Fig. 6.—Set of Sandbags.

keenness of the graver; the graver so treated produces a brilliant cut.

Work being engraved is often supported on a round leather pad or cushion, which allows it to be turned about in any direction; a set of these pads is shown by Fig. 6. They are made of leather in all sizes, from 1 in. to 12 in. or more in diameter. They are machine-sewn all round with strong waxed thread; a small hole, however, is left, and through this the pad is filled with dry sand, the hole being then stitched up by hand with waxed thread.

Magnifying glasses are necessary when fine work is being engraved. The watchmaker's ordinary eye-glass (Fig. 7) is much used for small work, but for

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large work is used a larger glass, mounted on a stand with a projecting arm, which can be raised and lowered, and also swivelled round in any direction circumstances may require (see Fig. 8).

The gravers, the tools actually used in the process of engraving, now claim attention.

Fig. 7.

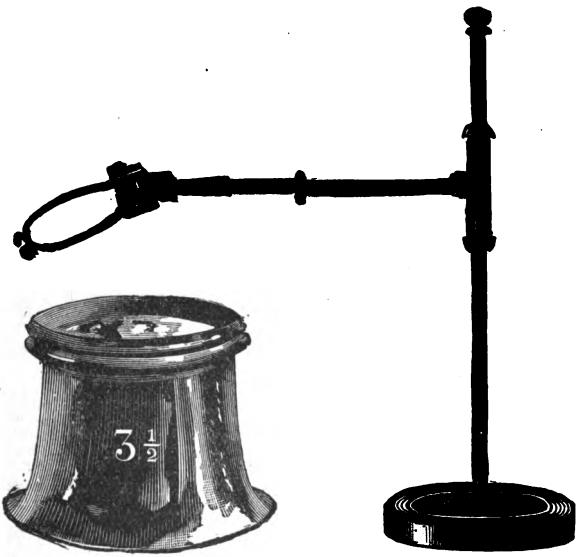

Fig. 8.

Fig. 7.—Engraver's Eyeglass; Fig. 8.—Eyeglass Stand.

The term "graver" is applied to all the cutting instruments used by the engraver, except the "chisel," whose meaning and use are obvious. The general term of "graver" gives place to a more distinctive term when the graver has been whetted to the form or angle required by the workman; for instance, angle graver, flat graver, shading graver, etc.

Thus, again, when a graver is whetted to form a

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semicircular cutting face the graver is termed a round-nosed or spotting tool, for the simple reason that when used it makes a round spot, or if the cut be prolonged a groove.

Round-nose gravers are used for cutting dots, as in periods, the dot of the letter *i*, the terminals of *s*, *c*, *r*, etc. These gravers are made thin, with the belly part rounded, so that the groove it ploughs in the metal is part of a circle or half round, corresponding in width with the thickness of the tool. Several sizes, varying in thickness, will be found useful. These tools are ground on the face only. The belly should never be sharpened, or the semicircular form of the cutting edge will be spoiled.

The ordinary taper square graver, about No. 2 size of Peter Stubbs's make, is a capital tool for nearly all kinds of light cut work; this tool tapers from the point, gradually increasing in thickness till the "tang" is reached. By using these tools in sizes 1, 2, 3 the use of a grindstone may be dispensed with.

With regard to the special work to which each style of graver is put, generally speaking, the shank or some other portion of a letter is cut with a flat tool and finished with a lozenge graver whetted on three faces. Block lettering is wholly cut with a flat tool. Old English is cut with two flat tools of different widths, and finished with an angle graver; for this reason the work looks regular, is of equal size throughout, and is kept straight by working between parallel lines. Letters with flat bottoms are cut with a square or lozenge-shaped graver whetted at an acute angle, and then flattened off to the width of the letters which are to be cut. A great deal of cheap lettering is done with a shading graver of the required width of cut, and then finished with the ordinary angle graver.

The curved graver is most useful when deep hollows are to be engraved; and in whetting a less

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"set-off" (see pp. 37 and 38) is given with the same effect, the tool having greater power in the hands of the workman. For small articles of plate or precious metal, straight shading gravers are used, but for large silver work the curved shader is unequalled.

Shading gravers are a special manufacture, and are most excellent and easy cutting tools; they are made of various degrees of fineness and of differ-

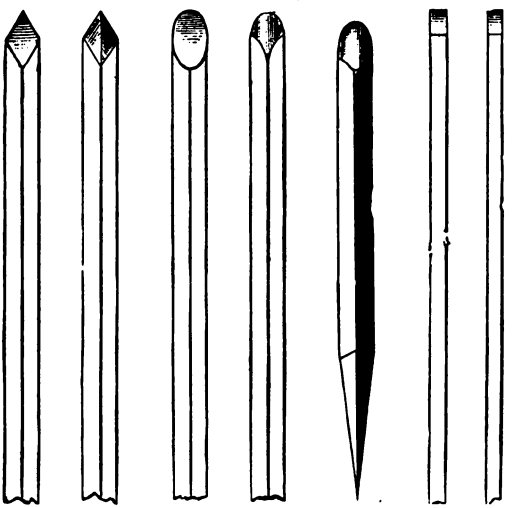

Fig. 9. Fig. 10. Fig. 11. Fig. 12. Fig. 13. Fig. 14. Fig. 15.

Fig. 9.—Back of Angle Graver; Fig. 10.—Belly of Angle Graver; Fig. 11.—Back of Round-nosed Graver; Figs. 12 and 13.—Belly of Round-nosed Graver; Fig. 14.—Back of Flat Graver; Fig. 15.—Belly of Flat Graver.

ent widths. Those of "D" fineness of thread, and Nos. 4, 5, and 6 widths, will be useful, and for cheap work a graver of No. 12 width will cover the ground quickly.

Illustrations of gravers given in these pages are explained thus: Figs. 9 and 10 show respectively

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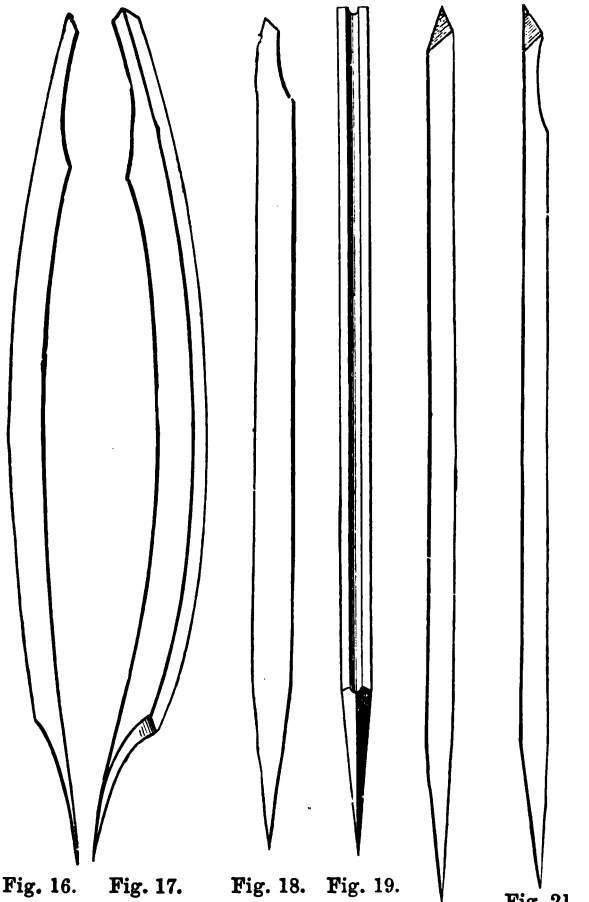

Fig. 16. Fig. 17. Fig. 18. Fig. 19. Fig. 20. Fig. 21.

Fig. 16.—Back of Shading Graver; Fig. 17.—Belly of Shading Graver; Fig. 18. — Scorper or Wriggling Graver; Fig. 19.—Double Wriggling Graver; Figs. 20 and 21.—Set of Gravers.

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the back and belly of an angle graver used for outlining, etc.; Figs. 11 and 12, the back and belly of a round-nosed graver used for spotting, etc.; Fig. 13, the belly of a large round-nosed graver; Figs. 14 and 15, the back and belly of a flat graver; Figs. 16

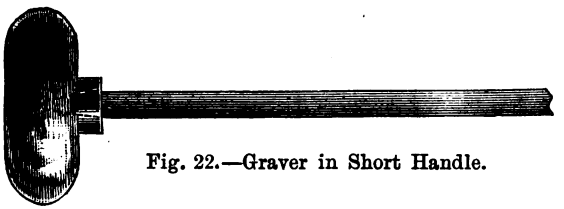

Fig. 22.—Graver in Short Handle.

and 17, the back and belly of a shading graver; Fig. 18, a flat graver or scorper, known also as a wriggling graver; Fig. 19, the belly of a double wriggling graver; Figs. 20 and 21, gravers set off at certain angles (see p. 37); Fig. 22, a graver in a short

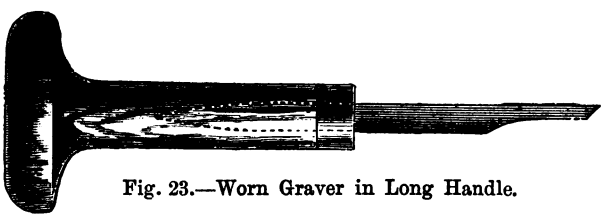

Fig. 23.—Worn Graver in Long Handle.

handle; and Fig. 23, a short, worn graver in a long handle.

The heavier kind of engraving is done with chisels, which may be lozenge-shaped, flat, or round-nosed. Fig. 24 shows an outlining chisel; Fig. 25, a narrow, flat chisel; and Fig. 26, a broad, flat chisel. These chisels may be made out of disused spindles, which, as a rule, are very good steel. A hammer for use with the chisels is illustrated by Fig. 27.

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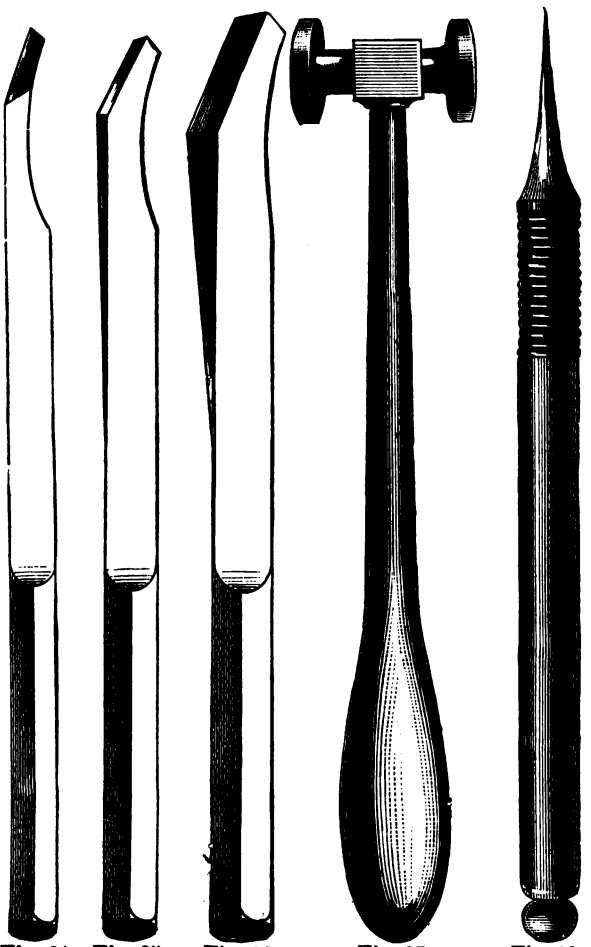

Fig. 24. Fig. 25. Fig. 26. Fig. 27. Fig. 28.

Fig. 24.—Outlining Chisel; Fig. 25.—Narrow Flat Chisel; Fig. 26.—Broad Flat Chisel; Fig. 27.—Hammer; Fig. 28.—Tracing Point or Etching Needle.

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For drawing outlines the steel tracing point or etching needle is the tool used; this tool is illustrated by Fig. 28 on the preceding page.

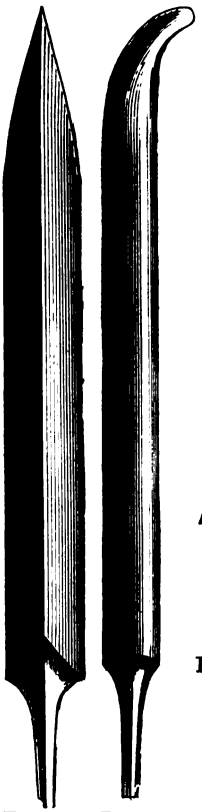

Fig. 29. Fig. 30.

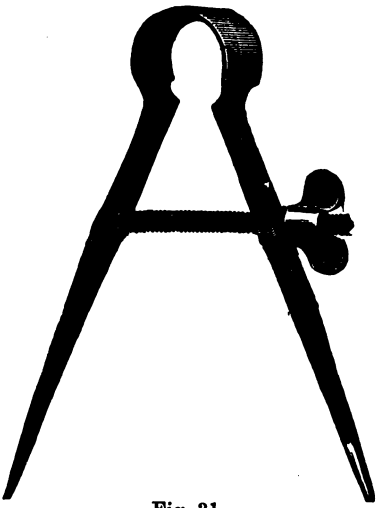

Fig. 31.

Fig. 29.—Scraper; Fig. 30.—Oval Burnisher; Fig. 31.—Spring Dividers.

Other tools required are a scraper (Fig. 29) for removing the burr thrown up by graver or chisel, an oval burnisher (Fig. 30), a pair of spring

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dividers (Fig. 31), and a serviceable pair of compasses. A strongly made set of drawing instruments would also come in handy.

Engravers' punches usually are made by engravers themselves, and consist of short steel punches set in handles like gravers. They are used chiefly to repeat a small ornament with precision, a mark being made on the article to be engraved by the punch, and the faint mark thus made afterwards being re-cut with the graver.

The process of whetting or sharpening an ordinary line-cutting graver will now be described. First clean the oil-stone (if a new one) with turps or paraffin, and put a few drops of neatsfoot oil upon it; this oil is dear, but a little goes a long way, and it does not clog. With the finger lay the oil evenly all over the surface of the stone. Take a new graver, and break off half an inch of the soft end or tang, as it is called, and gently tap the tang of the graver home into a short handle (see Fig. 22), supporting the point of the graver upon a piece of brass while driving on the handle. Graver handles usually have holes made in them to receive the tang. Taking the graver in the right hand, lay it flat on the oil-stone, the bright side or belly of the graver downwards. Place the first and second fingers of the left hand on the end of the graver to keep it in position, and raise the handle of the graver five or ten degrees, still keeping the point on the stone; then turn the graver slightly inwards and commence rubbing the graver up and down the stone, keeping the tool at the same inclination until the right-hand facet is formed. The method of whetting or re-sharpening gravers is shown in Fig. 32. If this operation is done nicely, a flat bevel or facet will be formed from the point of the tool to the extent of about $\frac{1}{8}$ in. up the side of the graver. When this has been done, turn the belly of the graver on its right side and repeat the process till a corresponding facet has

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been produced, leaving the junction of the two newly formed facets in a line with the belly of the graver, but at a lower level (see Figs. 9, 10, and 20). This shape will enable the engraver to cut a perfectly straight or circular line at will. If the angle bears to the right hand or to the left hand, the graver cannot be made to follow truly the line which is to be cut; therefore the graver must be whetted again and again until the angle of the facets is in line with the centre of the belly of the graver.

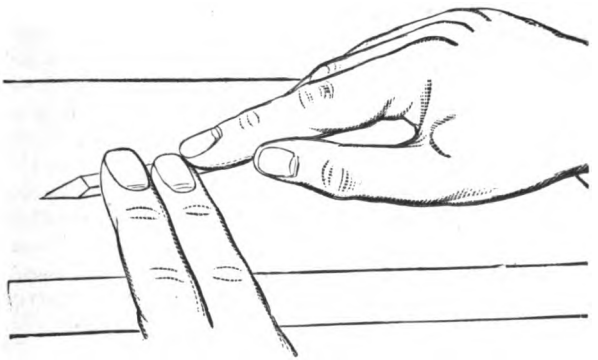

Fig. 32.—Method of Sharpening Graver.

Whether this is so can be seen easily by holding the graver towards the light and looking along its belly. This point is of the greatest importance, but presents some difficulty to the beginner, who will require a little experience before he is able to whet gravers to suit his own hand; a practised hand can whet a graver in but a few minutes. The operation of raising the graver handle when forming new facets is termed "setting off" the graver, and the "set off" of a graver ranges, in extent, from 5° to 45°, according to the concavity of the work. For convex work the set-off is slight, but for flat

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work it is very pronounced, in order to prevent the handle of the tool from scraping the surface of the work, especially when the size of the job exceeds the length of the graver itself. Suppose that the bottom of a cake basket is to be engraved; it is possible for this to be some three or four inches deeper than the outside mount. The graver then will require a "set-off" at an angle of 30° to 45°. In the workshop, gravers are kept handy, each whetted to serve its particular purpose; so that often from fifty to one hundred gravers, whetted in many styles, may be found in one shop.

A graver that has had two facets rubbed on its sides will require, before use, to be sharpened on its back—that is, on the side opposite to the facets. Turn the graver with its back on the stone, at an angle of from 30° to 45°, and rub it until a satisfactory point is obtained, which may be known by trying the point on the thumb nail. If the point is dull it will slide over the surface of the nail, but if sharp it will cut the nail. Do not rub the oil-stone always in the same place, but use it equally all over the surface, and wear the stone as evenly as possible.

From time to time the point of the graver will require to be renewed by turning the belly of the tool upwards, rubbing the back up and down the stone at an angle of from 30° to 45°, according to the set-off of the graver.

Gravers that have been sharpened on an oil-stone should have their cutting angles polished by stroking them on a piece of leather which has been very lightly rubbed with jewellers' rouge.

To prepare a flat tool for lettering, whet each side of the belly or under side of a lozenge graver at an acute angle, the sharper the better, and then rub away the angle thus formed until a flat is formed of a width suitable for the letters to be cut; then sharpen as from the back as usual. A very moderate

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set-off or bevel is required for flat work, as if the bevel is too great it will cause the tool to slip over the boundary lines, and consequently spoil the work.

With regard to the process of whetting a shading graver, the cutting face is already prepared by being cut with a series of fine grooves; therefore it only requires to be sharpened on the back, holding it fairly straight at an angle of from 30° to 45°.

The "wriggling" tool is a flat tool with a square cutting-face, like the shading graver, but is not "lined" or grooved on the belly. To whet this tool, lay the belly flat on the oil-stone, raising the hand about 5°, and form a bevel of about $\frac{1}{16}$ in., and finish as for the shading graver.

A rough oil-stone will leave a burr on the edges of the graver. A graver of soft steel will also develop a burr after having been whetted; either of these conditions producing a "grey" cut, and a burr also more or less pronounced. A burr will be thrown up by a graver sharpened at a very acute angle, if the tool has not been skilfully whetted. For pewter, and lead especially, the belly angles of the graver should not be acute, neither should the depth of cut be great.

For copperplate engraving the lozenge graver is most commonly used, whetted to the various angles required by the work in hand, hardly any set-off being wanted to these gravers, owing to the flatness of the work. The beginner must be prepared for a few difficulties in cutting copper, as there is difficulty in producing a smooth cut.

The manner in which a graver is hardened and tempered greatly influences its cutting properties and capability of receiving a fine point. The points of gravers when too hard break off, when too soft they rub off, and when burnt in the hardening they are useless. When tempering gravers, heat to a light straw colour, and then cool in clean cold water, moving the tool about in the water while cooling.

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For engraving on steel of a medium degree of softness, a Stubbs's graver let down to a deep straw colour will stand very well if the belly of the graver has been properly whetted and the back sharpened at an obtuse angle. For gold and silver a similar tool, suitably whetted on the belly and a less obtuse angle on the back, should be let down to a medium straw colour, not quite so deep as for steel. For nickel, German silver, and hard aluminium, a tool tempered as for steel may be employed; but much depends on the whetting.

The fact that the point of a new graver breaks off or is rubbed away rapidly does not prove necessarily that the tool is a bad one, as it sometimes happens that the end has become overheated during the grinding or tempering. The best thing to do with a graver whose point breaks is to break off about ½ in. and re-whet it. If the new point breaks also, let down the temper a shade or two, heating the graver on the end of a red-hot poker to a faint straw colour, and plunging into clean cold water immediately. In the case of the point of the graver rubbing away, the tool must be re-hardened and re-tempered. To harden it, heat in a clear fire to a cherry red, and plunge into cold water; then rub one side of the graver with a piece of stone till bright, and temper as before directed.

Gravers are broken off short in a very simple manner. Place the graver intended to be shortened in a hand vice, with the end to be broken off projecting from the jaws. With a pair of pliers firmly nip the end, and sharply bend off the end of the graver.

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CHAPTER III.

ELEMENTARY EXERCISES IN ENGRAVING.

THERE are many methods of teaching the art and practice of engraving adopted by professionals; but probably the best plan is for the beginner to obtain practice on a flat plate of common metal, such as German silver. Such a practice plate may be obtained of a metal dealer at the rate of about 1s. 4d. per pound, according to the state of the metal market. A suitable size is 6 in. square, hammered flat, and buffed or polished, and cut into convenient sizes for mounting on the cement block. This block is a piece of mahogany, 6 in. by 6 in. by 1 in., plain sawn. Engravers' cement may be bought from an oilman, or can be made easily as follows: Melt in a stone pipkin, placed in an oven, 1 lb. of Swedish pitch, and mix with it 1½ lb. of plaster of paris; thoroughly incorporate the mixture, and pour while in a liquid state upon the block, spreading evenly all over the surface; warm the plate, lay it on the cement, and press it down firmly, and when set it will be ready to work upon. On future occasions it will suffice to warm the old cement at the fire or over the gas, taking care that the cement is not smoked or burned. If while hot any of the cement drops upon the fingers, it will cause an ugly burn which may take a long time to heal.

The principles governing the mechanical action of the graver must be understood first of all. The act of ploughing earth illustrates the action of a graver, the plough being the graver, the earth the plate to be cut, the motive power being applied in front of the plough instead of from behind, as in

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the graver; but this makes no difference in the analysis of the action of the tool. Obviously the form of the plough will determine the shape of the cut; also the characteristics of the soil will modify the effect of the tool. Again, the angle or pitch of direction taken by the point of the ploughshare in relation to the surface of the ground is an essential consideration in determining the depth to which the groove will be cut. Thus it is with the point of the graver. The angle that the face of the graver makes with the plate determines the tendency of the tool to run either into or out of the metal; and this angle is controlled by the amount of elevation of the handle above the plate. In practice it is necessary to allow room for a handle, and space for the fingers in holding it; consequently the angle which the point makes with the plate will be one tending to draw the tool deeper and deeper below the surface; this tendency can be counteracted by lowering the hand towards the plate until want of space prevents this. There are two modes of correcting the tendency—first, the lower side of the tool handle may be cut away; and secondly, the two under surfaces of the graver may be ground away, thus forming a new belly at a greater angle with the face of the graver; of course, the set-off or angle of this belly will determine the amount of elevation allowed to the handle. In using the graver the action of the plough must be remembered. When the tool is driven straight forward the character of the cut will be governed by the position in which the tool is held. If the belly is exactly under the upper corner the cut made will have its sides equally inclined. If the graver is rolled over towards the left the cut may be perpendicular on one side, with a long incline on the other; whereas if the tool is rolled over towards the right, the shape of cut will be the same, but the perpendicular and inclined sides will be reversed.

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Practice now should be begun on the prepared plate. Stand the block upon the second size sand-bag, Fig. 6, p. 28, and to find the centre of the plate draw diagonals and note where they intersect. Then, with the spring dividers or with compasses, strike on the plate a number of circles, increasing in size till the outside edge of the plate is reached (see Fig. 33).

The method of holding the graver is as follows.

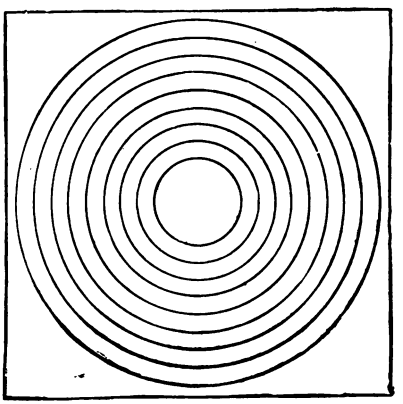

Fig. 33.—Practice Plate.

Take it in the right hand (Fig. 34), with the handle in the palm, grasping firmly with the forefinger and thumb. Hold the block with the second, third, and fourth fingers and thumb of the left hand, the first finger of the left hand being at liberty to place in front of the thumb of the right hand, to prevent the graver slipping.

The hand, not the arm, is used to propel the graver, the length of stroke but rarely exceeding an inch. When the length of the cut exceeds the length of the stroke the thumb is moved forward and replanted firmly on the plate. The graver is

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drawn back by the muscles of the hand, the point is placed in the cut, and another forward stroke made. This movement is much more easily made than described, and the beginner will soon learn that the thumb is the mainstay in guiding the graver when cutting all sorts of lines. The thumb is of great importance in forming curves, for then it is used as a fulcrum about which the graver is

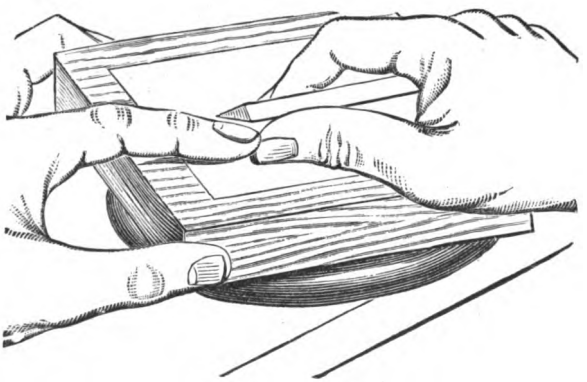

Fig. 34.—Method of Holding Graver.

revolved, thus ensuring a perfection of form which would not otherwise be readily obtained.

Now make an attempt to cut the smallest circle described on the plate (Fig. 33); place the point of the graver on the line of the smallest circle, gently raising the graver and pushing it forward till the graver begins to cut. Continue the cut, gradually turning round the plate towards the right hand, and cutting towards the left hand, from A to B, Fig. 35, keeping the forefinger of the left hand in contact with the thumb of the right hand. The thumb of the right hand will slide over the work in the rear of the cut, and the beginner had better wear a

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leather thumb-stall until the end of the thumb becomes hardened. As it is necessary to be able to cut from left to right, as well as from right to left, for the sake of practice cut the second circle in the reverse direction, that is from left to right, C to D (Fig. 35), in other respects proceeding as before By this time the graver, what with slipping about and digging into the metal, will be quite dull, and its point must be renewed (see p. 38). Continue to cut the remaining circles by the above rules, cutting to the right and to the left alternately.

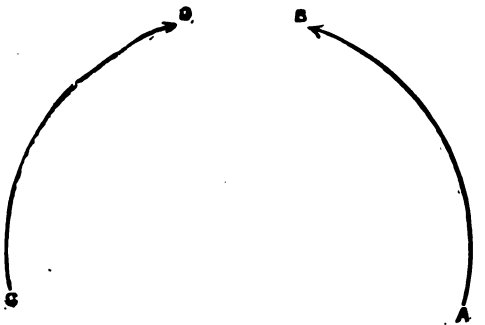

Fig. 35.—Direction of Circular Cuts.

The constant inclination of the graver to slip out of the cut, making a line off into space will trouble the beginner. The graver belly is a curved line, convex towards the surface of the engraving, and if the hand which drives the graver is lowered it instantly throws the point upwards and a slip consequently ensues. If the reverse motion takes place, and the hand is raised a little too high, the point at once "digs in," and the result is either a cut wider than was intended or the graver comes to a dead stop. Practice alone will give the necessary sense of touch and muscular control over the graver, enabling an even line to be cut by main-

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taining an equal elevation of the hand. On a plain surface the danger of a slip is not nearly so great as when the surface is considerably convex.

In cutting curved lines it is important to observe which side of the cut is perpendicular and which inclined, because in making the curve the handle of the graver describes a large circle, the point being a constant fulcrum, and the moment the body of the graver deviates from following the point in a straight line the belly of the tool has a tendency to touch one of the edges of the groove already cut. This action will be fully comprehended by supposing the graver to be laid down its whole length in a straight cut with the point kept down; any attempt made to swing the handle round to right or left will cause one or other of the corners to be torn away and damaged by the belly part of the graver. This explains why the graver must always be rolled over towards the convex side of a curved line, as in that position an incline is smoothly cut by the face of the graver, which allows the belly to come out without touching the corner. This peculiar motion of the graver, producing a cut of a varied width according to the rolling over, is of constant service in forming and widening the lines of script letters, both small and capitals, thick and thin lines being cut one into the other in a manner not to be accomplished by other means.

When one side of the plate has been engraved, the other side can be done. Knock off the plate, and rub the dirty side with a piece of tallow candle to remove the cement, and warm the plate over the gas, holding one corner with a pair of pliers; wipe clean with a piece of rag. Then, as before, mount the plate on the block, the engraved side down. For practice, rule parallel lines on the plate ½ in. apart, ruling cross lines to form ½ in. squares, which may now be engraved. These lines being cut, fill in the squares with lines running diagonally from corner

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to corner, about $\frac{1}{32}$ in. apart, and of equal depth. The lines of one square should run in a direction opposite to those of the next square, as indicated in Fig. 36. This kind of filling is termed colouring, and done in a regular manner makes a good background for ecclesiastical lettering and ornament.

In making short cuts in line work, the graver is manipulated in a manner different to when cutting a long continuous line. The method or knack of

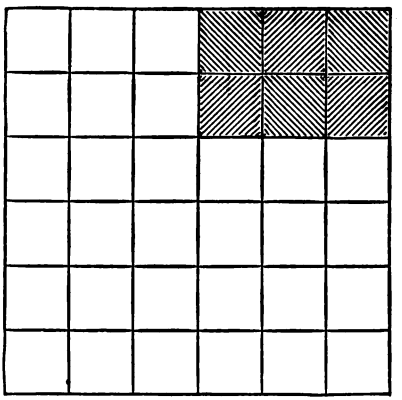

Fig. 36.—Colouring on Practice Plate.

springing the graver forward when within a short distance of the stopping line is peculiar and effective, and is acquired only after considerable practice; but once acquired it comes in handy for finishing the cut on all kinds of work, whether colouring, veining, shading, or blacking out groundwork.

To prepare a surface for engraving, first it is dimmed with grease, applied with the fingers—candle grease, or even a rub on the oiled hair will furnish enough; on this dimmed surface the design has to be drawn. To rule straight lines on a flat

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surface a thin blade of steel is used as a guide; lines on a circular surface, as a cup, or round a napkin ring, are drawn by means of a pencil point fastened at right angles to a small rod, which the engraver holds between his fingers at the edge of the article; and on turning the article round a line is drawn parallel with the edge, at a distance equal to the amount of rod between the fingers and the marking point. Some rods have a flexible joint and screw which enables the pencil to be set at any angle required for the work. This adjustment is specially serviceable for the insides of irregular-shaped articles, and those which have the part to be marked at an acute angle with the edge. The pencil used is made of boxwood, pointed in the usual way, and although it will trace legible lines on the dimmed surface, it will not scratch the metal as steel points would. These boxwood pencils can also be used to sketch out the letters and designs.

When as much practice as possible has been had with the practice-plate, work of real utility may be attempted. The material must be cheap, however, as the beginner is fairly certain to have many failures at first. One of the cheapest things on which a beginner can try his hand is a 12-in. brass tray or waiter, either round, oval, or octagon. These waiters, when engraved, plated, and finished, should command a ready sale at bazaars, etc. The design should be pretty and effective, with just enough work in it to be well balanced. Of the many suitable styles the beginner may prefer the one shown by Fig. 37, which may be engraved in five sections.

To set out the design, first warm the centre of the waiter, and rub on it a little beeswax, and place on the wax while it is hot a piece of rather thin zinc —say, one-half inch square. When the wax is cold the zinc adheres, and the point of the compasses is prevented from digging into the waiter. With the

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compasses strike faintly all the circles needed for the pattern, and accurately divide the waiter into fifteen equal parts by stepping it round with the compasses. Thus there will be five sections, each

Fig. 37.—Part Design on Waiter.

containing three divisions, two for the panel and one for the ivy leaf spray. With a graver cut the outer lines of the panels; trace the inner lines by drawing along the spring dividers

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set to the proper width, one point of the dividers running in the cut just made on the outer line. Cut all these inner lines, and these then will border the space in which to sketch the scroll work. To set out the scroll work, first draw a straight line down the centre of the panel, and sketch in correctly, afterwards tracing it with the point or etching needle (Fig. 28, p. 34); then outline it with the graver. Sketch in the spray to the right, point in and outline, and proceed in like manner with the outside and inside borders. On the line down the centre of the panel cut an almost imperceptible dot or speck, so that the exact centre may be recognised. One section having been outlined, the design will have to be duplicated upon the four other sections. To do this, an impression is taken on paper, termed a "white" or "dry" print. This is done in the same manner as the taking of an ink print (see p. 57), with the exception that chalk instead of ink is used. Damp a piece of good white or blue unruled paper, lay it on the engraved design, a piece of notepaper over that, and lastly a piece of parchment paper. Thoroughly rub with the smooth end of the tracing point handle, and the damp paper will be forced into the engraved lines. Take off the paper when a good impression has been obtained, and dry it gradually and thoroughly. Now make a pounce bag by crushing fine an ounce or so of common dry whiting, and enclosing it in a piece of well-washed linen. Cut from the white print all superfluous paper, and cut an oval-shaped hole in the top and bottom of the paper print exactly down the centre. Draw a centre line down the remaining four panels, and rub just the least bit of candle grease on the surface of each and where the ivy spray is to come. With the pounce bag dust the raised side of print, and "lay down" all the panels in turn. The pattern will fit exactly if the waiter was divided accurately.

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The borders in the design, Fig. 37, are little else than outlining, thickening, and colouring, and these form excellent practice, while the scroll and leaf work will be an agreeable change. Work slowly at first, frequently pausing to see that the work is uniform. The leaves of the ivy spray may be blacked out with the shading graver, and lightly veined, and the panels blacked out with either the graver or the shader, according to the time it is desired to spend upon the work. The scroll work will not want much shading, and the thickening must be done with care and judgment. The engraver is assumed to have some knowledge of the treatment of ornament as far as regards the shading, etc.; space does not allow of instruction being given in this subject, which is fully dealt with in the companion handbook, Design and Decoration of all Ages for all Purposes.

Fig. 38 is a sketch of an old-fashioned Britannia metal teapot, which now is again fashionable; the design shown is cheaply executed but is very effective. The details of the design will rest on the individual taste of the engraver. The chief ornament is the wide border, with arches and drooping fleurs-de-lis. For the double lines of the top and bottom borders a double wriggling graver (Fig. 19, p. 32) is used, this tool being made in many different widths, consisting of a flat or ordinary wriggling graver, with a groove cut straight down the centre; the tool is set off only slightly, and is whetted on the back in the usual way. In addition to the ordinary graver will be required a large round-nosed graver for the bright leaves of the top and bottom borders; a smaller one for the small spots; and a narrow flat graver or wriggler for the waved lines of the bottom border, and the waved line of the spray in the hollow section at the top.

To properly set out the design, with the dividers rule two single lines to form the border near the

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angle of the join where the hollow at the top of the teapot commences. Rule similar lines of the required width for the bottom border, using the bot-

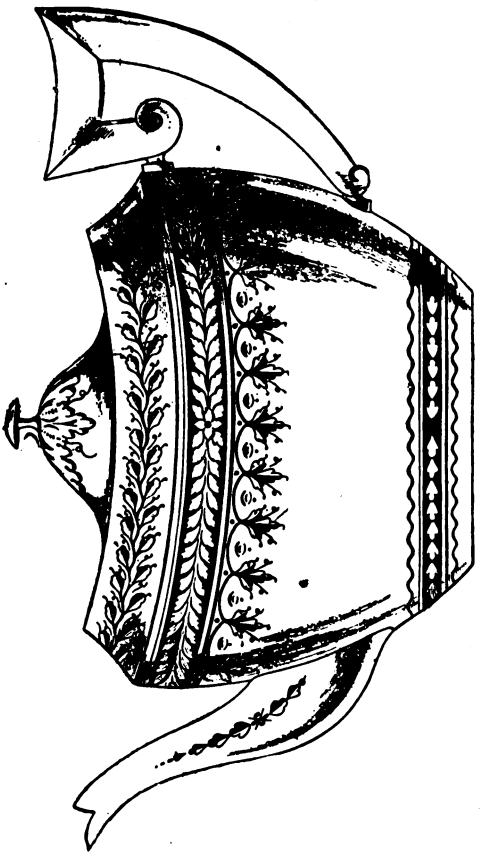

Fig. 38.—Design for Engraved Teapot.

tom of the teapot as a guide for the dividers, which are used as scribers in these operations. Using a double wriggling graver of the proper width, push it

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forward with a regular rocking motion of the wrist, thus making a continuous dotted double line if the tool is used properly. All these double lines are done with the same graver. Now change the tool for the narrow wriggler, and cut the waved lines on each side of the bottom border, and a rather deeper and bolder wave for the spray at the top of the teapot. With a No. 12 width shading graver cut away the whole of the space between the lines of the bottom border, cutting lengthways. Draw a pencil line down the exact centre of the teapot, and cut the four small bright spots shown in the bottom border. Now step out with the dividers the intervals for the bright leaves in the bottom border, and form them with two cuts—a deep and bold cut, followed by a light one in the first to clear the cut, and also to bring it to its proper size. Use a large round-nosed graver (Fig. 13, p. 31), and to make it cut so as to leave a bright surface rub the cutting angles on a leather on which jewellers' rouge has been sprinkled. It will be seen that the points of the leaves in both of the borders extend from the centre, and are carried round the teapot as far as the spout and handle respectively. Cut the oval form left by the round tool into shape with an ordinary graver, flanching or cutting with the point and right or left side of the graver, making two cuts on each side of the leaf. The ornament on the spout is done in a similar way, with the exception that the leaves are graduated. For the top border use the No. 12 shading graver, and make a cut, the width of the graver only, on the inner sides of the double lines already cut. Rule a line along the centre of the border, and with the large round graver cut the four-leaved flower in the centre; next mark out the leaves with the point or etching needle, setting out the angles of the leaves accurately and at equal distances, and rough out the shape of the leaves, as in the bottom border, with the round graver, and cut them up in

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the same manner, giving the leaves a slight curve, as shown in Fig. 38.

The spray in the hollow section now remains to be engraved; the leaves may be wriggled with the No. 12 shading graver, and relieved by three or four cuts on each side of the leaf, giving them their proper form as the work progresses. These leaves may be lightly veined and sprigged as shown.

The arches under the top border must be stepped out with the spring dividers, and wriggled with the narrow graver used for the waved lines. The leaves at the points of the arches may be wriggled with the No. 12 shading graver, and cut up in the same style as the spray in the hollow. A small spot between the arches, and a large spot with smaller one beneath in bend of arch, complete the design. The work on the lid is outlined with line-cutting graver and finished with shading graver.

Fig. 39 is a line design in the popular floral style for a plain oval teapot; the lid is flat and let in, and thus forms a smooth surface to work upon. It is proposed to leave this design to be dealt with according to the taste of the engraver, but, of course, the ornament on the lid should correspond with that of the body of the teapot.

Engraving on pewter is good practice for the beginner, as the work does not involve the waste of costly material. Pewter engraving is a branch of the art almost exclusively confined to London, where pewter pots are extensively used. The vigorous method of cleaning them with sand tends to obliterate the engraving, which often wants renewing.

Pewter work is rather dirty, and owing to the presence of lead in the composition care should be taken to wash the hands after work. It is also advisable to wear an apron with a bib so as to avoid soiling the clothes, as the pewter, and most articles during the process of engraving, come in contact with the breast. The beginner attempting pewter

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engraving must be capable of using the graver, and probably he will drop easily into the style of letter-

Fig. 39.—Design on Oval Teapot.

ing, which in most cases is simply Italian or ordinary writing (Fig. 40), this being very simple. The inscription usually consists of the proprietor's name,

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with the name of the inn or hotel where the pewter pots are in use. Sometimes there may be a monogram engraved in ornamental cipher, with sprigging or spraying. Occasionally the engraving takes the form of a crest, as the "Boar's Head," in Fig. 41.

But very few tools are required for pewter engraving. A sandbag 6 in. in diameter, two or three gravers, a lead pencil, tracing point, oilstone, oil-can, small bottle of turpentine, paper, small pot of

Fig. 40.—Lettering on Pewter.

letterpress printing ink for taking black prints, pair of dividers, a short length of crinoline steel for ruling lines, and a few clean rags are all the tools likely to be required.

In renewing engraving on pewter pots, select the most legible engraving and recut the lines as carefully as possible. If the engraving is so far gone as to require re-drawing, draw a vertical line down the pot on the side opposite to the handle, and across this line, and at right angles to it, rule with the flexible steel parallel lines $\frac{3}{4}$ in. apart for the capital

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letters, and ¼ in. apart for the small letters. Rule these three lines in the centre, midway between top and bottom; the centre can be found by means of the dividers. Draw in the name carefully, balancing the inscription on each side of the vertical centre line. Now cut in carefully, making the curves graceful and the turns of the letters oval, thickening the down strokes, not forgetting the dots to the "i's" and the stops at the proper places. Any small but real improvement on the original design is allowable. Having thus re-cut one inscription, means

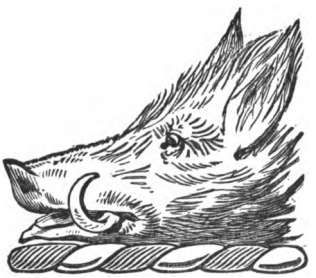

Fig. 41.—"Boar's Head" Crest for Pewter.

must be taken to get the other inscriptions uniform. For this purpose is taken a "black print." To do this, with the end of the finger rub a small quantity of ink into every cut. Then, with a piece of soft paper, wipe off all superfluous ink from the surface, leaving the ink in the cuts. Damp a piece of note-paper, lay it on the engraving, another piece of paper on top of that, and a piece of parchment on top of the whole, and rub with the round end of the handle of the point (Fig. 28, p. 34) on the parchment until the paper is forced into all the cuts, bringing away the ink contained in them. The paper taken from the engraving bears an inked reversed design in relief, and is termed a "black print," and if properly taken

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this will lay down a dozen or more impressions. As the impressions get faint, dust them over with the pounce bag (p. 50), which will make them plainer. If the ink is very soft, stiffen it by adding a very little finely powdered whiting and then it will not be so liable to smudge or smear. Draw the vertical centre line down all the pots to be engraved, mark with the dividers the height of the inscription, and proceed to "lay down" with the black print as many impressions as possible. With these impressions all pointing in is dispensed with, the inscription being cut direct from the print. Practice, and the use of a rather longer graver than usual, will soon accustom the worker to this.

The other style of engraving on pewters—ornamental cipher—is the same Italian lettering embellished with sprays, which are usually entwined, and the work is done in a similar manner to that just described.

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CHAPTER IV.

ENGRAVING PLATE AND PRECIOUS METALS.

ENGRAVING on metal is an art that cannot be learned from books alone, and, beyond a few simple instructions the student must depend on his practice and natural ability for the progress made. The basis of the whole art is good taste and an inherent aptitude for drawing. All designs, previous to being cut, must be sketched or drawn, and if the first outline is not considered equal to the style of work, it should be erased and re-drawn. There should be in all cases an artistic proportion observed in adapting the size and style of ornamentation to the object and space it has to decorate. In this, taste must be the guide; no rules can possibly be laid down. The location of the design, its position as a whole—either perfectly central, to the right or left, high or low—will make or mar the effect. Repeated trial will be necessary to meet the requirements of taste.

The directions given in this chapter are applicable to all kinds of small ornamental work in gold, silver, and plate. Sheet silver, which is recommended for practising upon, may be had from any refiner cut to shape. Nos. 5 or 6 sheet metal gauge are a suitable thickness. When the silver has been engraved upon it will be allowed for as scrap by the refiner, thus greatly reducing the cost of practice material.

The workman attempting to engrave gold and silver articles must have been prepared, by previous practice on the commoner kinds of metal, to give the proper artistic effect to the designs that may have to be engraved. It may be helpful to enumerate some of the articles usually engraved that

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may be included by the heading of this chapter. Besides jewellery proper, such as gold and silver brooches and earrings, lockets, rings, etc., the engraver has to work on gold and silver match-boxes and card-cases, certain parts of watch movements, watch-cases, tobacco-pipe and walking-stick mounts, and umbrella collars. An immense trade is now done in club badges of gold and silver; these are saw-pierced, and afterwards lightly engraved.

Of course, it is very seldom that one person is capable of undertaking this large variety of work, and consequently precious metal engraving is split up into a number of branches. Thus fish carvers, fish eaters, and general small work of an ornamental

Fig. 42.—Engraver's Bullet.

character are engraved by a man who seldom or never attempts any other description of work.

Gold and silver engraving must possess at least three striking features: a neat and graceful pattern or design; excellence of workmanship; and brightness of cut. The last is most essential, and covers some faults.

The engraver of articles dealt with in this chapter works at a three-hole semicircular bench under a strong window light, the window, if possible, having a northern aspect; for night work is employed a central gas-burner, in front of which is placed a glass globe filled with pure water. A light cardboard shade is worn over the eyes, and the light is so arranged as to fall directly upon the work.

This thick bench is made generally of such wood

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as elm, and has three semicircular pieces cut out, with arm-rests in between, these enabling three workmen to work near one window. Besides the burner that provides the light, there is a small gas burner at the engraver's right hand, for the purpose of warming the cement on the chucks on which are mounted the articles to be engraved.

The engraver suspends just beneath where his work rests a leather apron which catches all the gold and silver chips from the graver; these chips

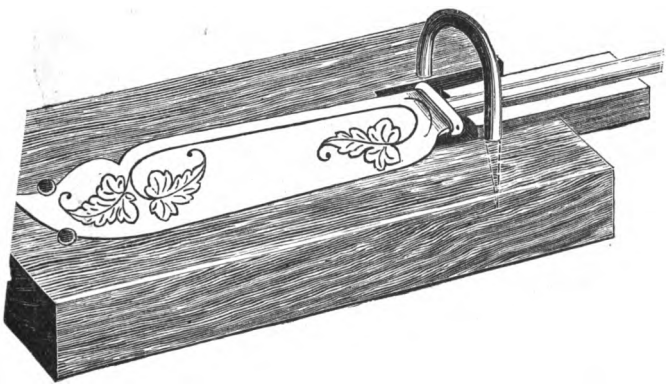

Fig. 43.—Support for Knife Blade whilst Engraving.

represent much value, and are swept up by means of a hare's foot. The sandbag used in this class of work has in its centre a round hole large enough to receive a bullet, this being really a small iron ball often having a screwed nose fixed to receive the screwed boxwood chucks. These chucks are round, about 2 in. by 1 in. thick, and carry a female screw of ⅝ diameter and eight threads to the inch. By means of the hollow pad and bullet, the engraver is enabled to quickly turn the work in any direction and at any angle which may be required during the progress of

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the work. Fig. 42 shows a bullet fitted somewhat differently from that above described.

The work is fixed on the small wood chuck with cement made for the purpose, and coloured red to prevent the staining of one's hands while in use. A wood block (Fig. 43) sometimes is used to hold fish carvers, eaters, and dessert blades whilst these are being engraved. Some other articles are held as best they may be in the left hand, or are mounted on a cement block as previously explained.

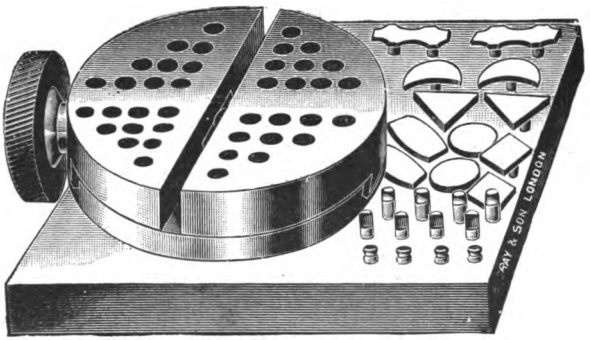

Fig. 44.—Engraver's Block.

For holding knives, forks, spoons, etc., small wood clamps are used. These blocks are about 4 in. high, the top being of an elliptical shape, and the blocks being split down through the centre. The clamp is divided in halves, slightly hollowed inside, and joined by a hinge at the bottom. The opening at the top is grooved to form a rest for the article held between the jaws. Slips of leather or wood are laid on the top of the grooves, according to the thickness of the plate to be placed on them, it being essential that the surface to be engraved shall be level with the top of the clamp. About halfway between the top and bottom of the clamp a bolt,

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with a fly-nut, passes through and draws the jaws together.

The engraver's block illustrated by Fig. 44 is small enough to be held in the hand, and it will take any one of twenty-four attachments of various shapes and sizes to suit different kinds of work. Fig. 45 shows another block made on a somewhat similar principle, having in a position a shield that has been engraved. Both of these blocks are made by E. Gray & Son.

Rings which have to be engraved on the outside are slipped on a smooth stick of wood, tapering so

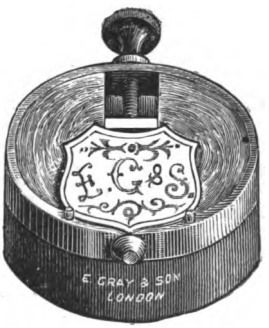

Fig. 45.—Engraver's Block.

that it will fit various sizes. When the inside has to be engraved the ring may be held in the fingers, resting on the cushion; napkin rings, pencils, heads of canes, cardcases, etc., are also held by the fingers. Thin plates of metal, such as the name-bars of watches, are fixed to small blocks of wood, either by tacks put round the edge of the plate or by cement. There are patent chucks on the market for holding work to be engraved, but these do not appear to be much used by practical men. However, Fig. 46 shows a support adapted for holding rings whilst they are being engraved. It is adjusted with the greatest ease.

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Walking-stick mounts to be engraved are pushed tightly on a short length of wood, turned taper. Stick knobs are mounted on cement sticks about 4 in. long, and when the gold or silver is very thin the piece is filled solid with cement. The article is warmed in the gas and taken off when engraved, and another substituted. Cleaning is done by soaking the mount in a bath of paraffin, where it remains till the cement is soft, when the mount is dried in successive sheet-iron boxes of boxwood sawdust, warmed by a gas jet underneath.

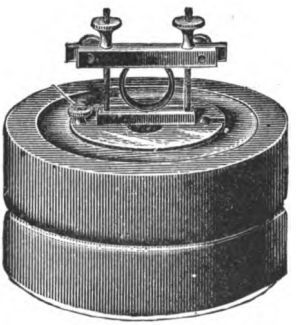

Fig. 46.—Support for Ring whilst Engraving.

A fair number of gravers is desirable for this work, so that the exact tool will be at hand when required, thus saving the time necessary for re-whetting. In brief, the tools required are the ordinary graver, the shading graver, a small spotting or round-nosed graver, narrow wrigglers and double wrigglers, with a tracing point and burnisher.

The gravers used for jewellery and other small articles made in gold and silver are not, on the whole, different from the ordinary tools, the only point of difference being in the whetting or sharpening. This difference, however, is very marked in the case of wrigglers and shading gravers; the wrig-

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gling tools are much narrower than those used by an engraver of larger work; and in addition the bellies of these wrigglers are lightly grooved like the shading graver; but, unlike the shading graver, they are quite straight, and not curved. The wrigglers generally used are of the same manufacture as that of the shading gravers, and may be briefly grouped as sizes A and B, Nos. 1, 2, and 3 of each. These, with their corresponding shading gravers, will prove a good assortment of (straight) wriggling tools and (curved) shading gravers for general small work.

With comparatively large designs which are repeated in sections, take great pains in placing the sections, using the dividers freely. Get the prints (p. 57) on truly, and the shields containing the design exactly upright. Point in the pattern exactly as it is intended to be cut, so far as the outline is concerned, and in setting out parallel lines scribe the second line from the first after outlining (see p. 49). In veining a scroll or leaf, study the pattern, and see that all radiating lines glide imperceptibly into the main vein. In cross shading and blacking out ground, see that whites are not left, and that the shading is graduated artistically. What are known as "whites" appear when the surface of the metal is not entirely cut away by the consecutive strokes of the graver. The finished work should be dusted over with the pounce bag and then polished, the dirt being removed from the cuts with a piece of raw indiarubber, not vulcanised rubber, as the sulphur in it will cause the article cleaned with it to turn black.

In engraving small work, much of it is done without the extra work of pointing in or tracing the pattern from the print. The work is cut from the print, which may be a black one (see p. 57) or a white dry one (see p. 50), according to the usual practice of the engraver. The white print may be preferred for its cleanliness, and also for its lasting

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properties; it requires renewing only occasionally, whereas a black one will lay down only from a dozen to eighteen impressions.

To cut a name—which may be in block letters or ordinary script writing—requires some care and good eyesight, or the aid of a magnifying glass (see p. 29). To do such work well and quickly, the learner should practise as much as possible on the practice plate. The general rule for setting out names on small work is to mark parallel lines with a rule, between which the name is set out in either block, Roman, or Italian letters. The two former have their shanks and thick portions cut with a narrow flat tool or scorper, formed as described on p. 38. The corners of the block and hair lines of the Roman letters are cut with a lining graver sharpened at an acute angle. In cutting the shanks and right angles of these, it is well to recut the opposite ends—that is, to cut them both ways—which has the effect of accurately squaring the corners of the letters. In the cases of the letters C, D, G, J, O, P, Q, R, S, and U, the straight or upright portions are first cut, the curves being added afterwards. Adopting this method, the engraver is able to produce a much better formed letter, when working with the flat tool, than if he attempted to cut the whole curved letter with a single stroke of the graver. Italian lettering is first outlined with a deep narrow cut, and then the downstrokes are thickened in accordance with the style shown in any book of alphabets.

In name engraving and that class of work, there will be difficulty in spacing the letters, the relative size of the small letters and capitals having a great effect on the general appearance of the work. When running letters, such as *m*, *n*, *u*, occur, one following another, they must be separated sufficiently to define each clearly, or they will have a crowded appearance; letters like *e*, *c*, *i*, etc., must

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be put nearer together, or they will present a scattered aspect. The angle of inclination is also very important; whatever the angle adopted, it must be rigidly adhered to throughout. Nothing, perhaps, so surely spoils the beauty of engraved letters as differing angles of inclination. Double letters, *l*, *f*, etc., need special care in this direction; and though the defect is not so obvious in capital letters or any which stand apart as it is in a connected series of small ones, still the greatest care must be exercised in all cases.

In ordinary ornamental engraving the finishing or thickening lines consist of a series of lines closely set together; in small gold and silver ornaments, one cut only serves the purpose. This cut is made with the side of the tool, having its point resting in the cut of the original outline, this producing a cut that appears to be deep whilst really the depth does not exceed that of the original outlining—a mere shave off the surface. The cut must be made quickly and with confidence, the knack being acquired only by constant practice. The right angle of the graver is mostly used, the bullet resting on the sandbag enabling the work to be turned quickly in any direction.

Letter engraving will now be treated in detail, the letter *M* being taken as an example. Draw or scratch a large sized *M* on the surface of the metal. The first cut in engraving will start from the bottom of the first stem of the letter, the graver being rolled to the right far enough to produce a cut of the full width of the stem. The graver will, of course, start from a point on the surface of the plate, and the cut will gradually widen as it penetrates the metal, until its width equals that determined for the body of the letter. When that position is attained, the graver must be kept at the same angle and driven up to the top of the stem. On reaching that point it must be rolled suddenly

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over to the left upon its own point as a fulcrum (see p. 42). This motion will throw the chip out, leaving the upper end of the cut rounded over towards the left-hand edge of the stem, having just the correct form to blend into the first curved hair line of the letter. This may now be cut by turning the plate partly round so as to set the point of the graver lightly at the very corner where the chip was thrown out, and then making a smooth flowing curved cut for the hair line; the curve will be best produced by a combined movement, swinging the plate round with the left hand, the graver being also swung round with the right. The double movement is not necessary, but is simply an economy of motion; for were the plate alone moved it would have to be for the whole amount of the curve, and the same distance would have to be got over if the graver were moved and the plate held stationary; the swing of the hand and arm in these long curves, embracing half a circle, would be very awkward and inconvenient. The hair line must not terminate abruptly, but, as the end is nearly reached, the graver point must be gradually brought to the surface and so should finally end.

The hair line may be begun from the outer end, and terminated by a careful junction with the stem of the letter. In this case the line must not begin too abruptly, but it will, of course, run into the previous cut at its full depth. Both of these methods should be practised, the one being used which is most readily applied. The bottom of the stem is as yet unfinished, as it terminates in a point, as produced by the graver entering the metal, instead of being perfectly square at the end. To cut this, the graver must be firmly set into the metal at the point where the stem was commenced, but in such a manner as to have the right-hand edge of the graver cutting the bottom of the stem at the horizontal line upon which the latter stands.

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The second stem of the letter is cut in precisely the same manner, except that the hair line is run into the body of the first stem. The third and last stem has to be formed in a slightly different manner, being rounded at both ends, thus terminating in hair lines curved in opposite directions. In this instance the graver must be set in to cut the body part of the stem far enough above the base line to allow room for the terminating curve; this line is made by two cuts instead of one, as in the others. Set the graver a little above the base line, and on the left-hand side of the stroke of the stem; roll the tool to the right so as to cut the full width desired, driving it up to the end, and throwing out the chip as before at the top; now turn the work half round, and repeat the operation for the other end of the stem. Thus the body will be cut out, with the two ends properly rounded for joining the hair lines, which are then cut in as before described. By using this method for cutting the body of this last stem, a diagonal elevated line is left standing in the cut, that is, the whole body of the stem is not cut to a uniform depth. This is the effect of cutting from two opposite directions; but should it be desired to have all the stems alike in appearance, this central ridge can be cut away; but perhaps a better way of securing uniformity is to cut all the stems from both directions. When this is done, first make all the cuts from the bottom upwards, then all those from the top downwards, and when the graver arrives at the base line, lift the chip out squarely. This will still leave the foot somewhat jagged, and it must be cut square with the side of the graver along the base line. By this process all the thick strokes will be alike in every part of the letter, and the general effect will be good.

As a further study, the curves forming such letters as *o*, *c*, *e*, *d*, *g*, etc., will form good prac-

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tice. The outlines must first be sketched as correctly as possible, as in the previous example. Suppose the letter selected is *o*. Begin the cut at the top very lightly, and with a gradually increasing pressure, and a gentle rolling of the graver over towards the right, proceed to the middle of the swell; then gradually diminish the pressure, and gradually roll the graver back to its original position, and throw out the chip at the surface of the work at the base line. This compound action of the graver is going on at the same time as the plate, and the hands holding the graver are making a partial and simultaneous curved motion corresponding with the semi-oval curve of the letter; thus half the *o* is formed, and the other half is cut by exactly the same movements, the hair line being continued till it joins the starting point.

The letter *e* is for the first part made in precisely the same way, with the hair line thrown a little towards the right, ready to join the succeeding letter; the upper and latter part of the letter is formed by starting a hair line about the middle of the body on the right and continuing it with a gradual swell, till the upper line of the letter is reached, the junction with the starting point being made by a sudden roll of the graver to the left, at the same time lifting out the chip. This method of joining a short swell and a hair line will require patient practice for some time.

The *a* can be formed by the same cuts as the *o* for the first part, and the preceding directions for making the stem of the *m* will be sufficient for forming the second part of the letter, except that the stem has to be reversed, and therefore commenced at the top; or it is often done by first making the swelled curve of the back, then the first cut of the stem, both cuts being made without reversing the plate; then turn the plate, complete the end of the stem, and finish both of the hair lines.

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The letter *c* is formed as is the *e*, with the exception of the dot at the top, which is made by setting the graver firmly into the metal from the top and giving a sudden roll towards the right, lifting out the chip at the same time; or the dot may be formed with a round-point graver.

The long stems of such letters as *t*, *d*, *p*, *q*, etc., claim attention, and these, although apparently easy to form, are really the most troublesome, and necessitate more careful practice than any of the others as yet described. This is accounted for by the length of the cut requiring the graver to be propelled almost the whole length of stroke the hand is capable of, according to the size of the letters. Constant uniformity of depth and width must be maintained, and the least change of elevation of the handle of the graver will drive it too deep, or, worse, allow it to dart across the plate.

In the practice of engraving, any method by which time can be economised without sacrificing effect is of the greatest importance. As an instance, suppose that each letter in a word is completed by itself, several cuts must be taken and the plate will have to be twisted about to engrave each letter; but if all the down strokes are cut at one time, all the up strokes at another, all the hair lines at another, and so on, the work will be got through by shifting it only two or three times, not only saving time, but producing uniformity.

Watch-cases have monograms engraved on their backs outside (see Chapter V.), and names and inscriptions engraved on the inside of the back and on the dome. But, before operating on a watch-case, the engraver should have gained as much experience as is possible. When engraving an inscription, which usually goes on the inside dome, the back of the case must come off. The inscription will then require to be set out, making "Presented" and the name prominent; Old English, block letters, and

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script may be used, according to taste and to the available space. Before using the graver, the inscription must be drawn in with a lead pencil on the article, on the surface of which a little grease has been smeared so as to lessen the brilliancy, and to make the pencil marks show to better advantage. Go over the pencil lines with the tracing point, and then put in all the thickening or relieving cuts; colour or shade the principal letter, and finish the whole. In cutting with the graver, the beginner will find it an advantage to place the forefinger of the left hand in front of the thumb of the right hand, thus preventing the graver from slipping, as shown by Fig. 34, p. 44.

When engraving a brooch, the method of procedure is as follows. Take a wood chuck, and to its top fix a small piece of jewellers' red cement, which has been warmed in the gas flame. Fashion the warm wax to the shape of a cone small enough to enter the brooch, and to completely fill the interior when pressed in, so that the thin shell of the brooch may be strengthened and the danger of bending or cutting through be lessened; there is always a danger of injuring these frail articles. When the cement has set, with a hard lead pencil draw the design, outline it with a light cut, cut away the ground, and vein and shade the ornament, and then it is ready for the important operation of finishing. The whole effect of the design is produced by the finishing cuts, which are made as follows. Whet a taper square graver (No. 2) to an angle between that of a lettering graver and one used for larger ornamental work. The graver must remove a chip of metal, and leave the cut surface intensely brilliant. To do this the graver must be properly whetted, and then polished on a soft buff-stick on which a little jewellers' rouge has been rubbed, lightly drawing the graver down on each angle two or three times; every time the point is renewed follow with a light rub on the buff.

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The erasure or obliteration of engraved monograms, crests, and other designs is work that the engraver sometimes has to attempt. The erasure of initials from a watch-case is a delicate job. If the letters are in the centre of an otherwise plain case, take a fine flat file (costing about 4d. at a jewellers' material dealer), and, with short, firm strokes, file out the letters. Then go over the surface with a piece of snakestone or Tam-o'-Shanter hone, and finish with putty powder on a piece of soft leather. If the letters are in a small shield, the tendency is to damage the outside work, which would require to be re-cut. With a small riffler, or bent file with a flat surface, file out the letters, dress with snakestone fashioned to a point, and finish as described above. Re-engraving tends to disguise the results of this process, the new design being relieved with light and graceful sprigged work.

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CHAPTER V.

ENGRAVING MONOGRAMS.

A MONOGRAM is a character of one or more letters interwoven, and is a familiar subject of ornamental engraved work. The various kinds of objects on which monograms are frequently engraved are far too numerous to particularise, but a few may be mentioned. The most common, table cutlery, forks, and spoons being excepted, are watch-cases, a large monogram being engraved on the otherwise quite plain back of the watch; the monogram is not too large if it is kept within the flat surface of the case no matter what size the watch may be. The design should be perfectly upright with the pendant of the watch.

Monograms which are to be engraved on objects having an oval outline must themselves be oval in character. For this purpose it is well to have at hand a number of ovals of different sizes cut in cardboard or thin brass; the best plan of securing a series of true ovals is to have them cut from thin sheet brass on a special lathe. A pencil drawn around such a template laid on the article to be engraved gives the outline within which the group of letters forming the monogram is to be confined.

Heraldic engraving and monogram engraving have much in common, and their successful practice depends not only on the ability of the engraver to outline and shade well, but also upon the facility with which he can enlarge or reduce a design to suit any particular piece of work. In addition, a study of heraldry is advised. A book of crests, in which the arms and crests have been printed by the copper-

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Fig. 47.

Fig. 48.

A M B

A M D

C V & Co.
Fig. 49.

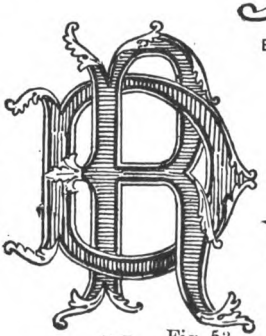
Fig. 50.

Fig. 51.

B M B

B M I

J B
Fig. 52.



D R Fig. 53.

B J
Fig. 54.

Figs. 47 to 54.—Monograms.

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plate process will give a capital idea of the shading of crest work, etc. A book of monograms will also be of assistance, and there are two or three suitable ones published, and a book of plain and ornamental capital letters, and an occasional glance at some high-class "Specimens of Printing," will keep the engraver up to the most modern styles of letterings.

The practice of letter and monogram engraving requires a certain style, which may be acquired by the observation of other engravers' work and the help of certain alphabets and books of monograms; but while certain rules are to be observed in the framing of inscriptions and the grouping of monograms, it is hoped that the reader, when more advanced, will attempt to produce original designs.

With regard to the tools used for engraving monograms, the following will be necessary: About half a dozen assorted gravers, tracing point, spring dividers, a set of four or five cushions or sand-bags, graduated to 1½ in. or 2 in. in diameter, oilstone, letterpress ink, a length of flexible steel for ruling lines, hard lead pencils, turps for cleaning ink out of the incised lines after prints have been taken, and a lump of raw (unvulcanised) indiarubber for cleaning-up the work when finished.

Engravers of fine work use either the watchmaker's eyeglass or the engraver's glass mounted on a stand, by which the magnifying glass may be retained at any required height or any position as shown on p. 29.

The gravers for monogram work must be properly sharpened. A lozenge graver, with a moderate set-off, is the best for this style of lettering; and a good test for a well-sharpened tool for this work is the production of a deep, narrow, and clean cut without burr or roughness of the edges of the cut. Another graver used sometimes in cipher work is a lozenge graver sharpened similarly to the one described

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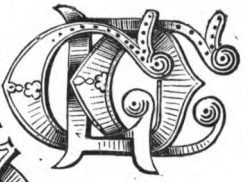
ELT
Fig. 55.



GCD
Fig. 56.

Fig. 57.

HEB

KZY
Fig. 58.

LF
Fig. 59.

HEB
Fig. 60.

E B W
Fig. 61.

GST Fig. 62.

Figs. 55 to 62.—Monograms.

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above, but with the angle rounded off so that it will cut a minute dot.

The grouping of a monogram is rather difficult, for though an expert designer will strike a circle large enough to embrace the monogram, intersect it by a perpendicular and a horizontal line, and then proceed to sketch in the subject without apparent difficulty, the beginner will be able to draw a fairly good monogram only after extensive practice. A good plan is to practise the sketching of approved figures or characters daily. The beginner may take a sheet of paper, and doubling it lengthways and also across, sketch in one quarter of the whole figure, and rub it down, or otherwise transfer it, by doubling the paper across the centre and rubbing the back of it, thus bringing down on the opposite side another quarter of the figure, and making one half. By re-pencilling the half of the figure, and doubling the paper at right angles to the former doubling, and going through the same process as before, equality in the monogram is obtained. A glance at the specimens illustrated by Figs. 47 to 84, pp. 75 to 83, will show how helpful such a method is in some cases. Of course, at this stage the drawing is still imperfect, and the necessary alterations and additions remain to be made. When these are done, blacken the back of the paper by rubbing it over and over again with a soft blacklead pencil, and it is ready for laying down. To do this, rub a little beeswax or white wax over the article which has been previously made warm. When it is cool, lay down the paper on the waxed surface, go over the lines of the perfect monogram (ignoring the false lines made by the double transfer), and the figure will appear in black lines on the surface of the wax. In sketching a monogram, the first and last letters should be made more prominent than the others; this is effected by the introduction of shaded lines, perpendicular, horizontal, and diagonal, and sometimes

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Fig. 63.

JWC

Fig. 64.

TLF

Fig. 65.

TGC

SW

Fig. 66.

VS & Co.

Fig. 67.

EL

Fig. 68.

HJE

Fig. 69.

Figs. 63 to 69.—Monograms.

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by engraving hair-lines on the inner outline of the letter; the principal letter of the group is, at times, further elaborated by the introduction of ornamental work within the hair-lines just referred to.

It often happens that one design has to be engraved in a series of sizes, and so the engraver should practise the drawing-in of the various sizes, which in a single series may run from 1½ in. in height down to ⅜ in. or less. The diagram (Fig. 70) indicates one method of enlargement and reduction, so as to obtain a series in graduated sizes. First, draw with a piece of flat flexible crinoline steel or its equivalent a straight ground-line, and erect verticals at each end; then measure off on the left-hand upright a distance of 1½ in., and on the right-hand one a distance of ⅜ in., and connect these points by an inclined line, shown dotted in Fig. 70. If the series is drawn on a German-silver plate kept for the purpose, it is sure to come in useful on a later occasion. These German-silver plates are about 6 in. square, and are polished on both sides, and if space is economised will hold a large number of letters. They are generally mounted on a pitch-block to preserve the reverse or back of the plate from scratches.

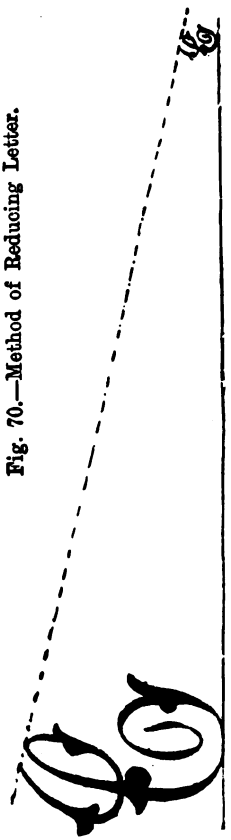

Fig. 70.—Method of Reducing Letter.

As an example, the process of engraving a monogram on a watch-case will be considered. Lay down,

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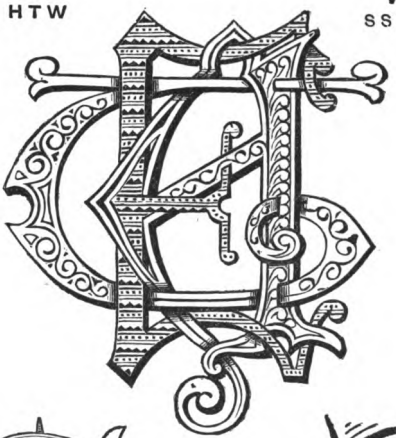
Fig. 71.

HTW

Fig. 72.

SSGC



AET

Fig. 73.

Fig. 74.

RT

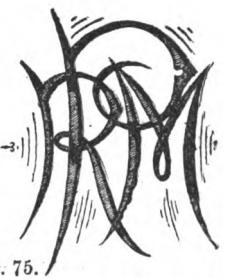


Fig. 75.

RMP

Figs. 71 to 75.—Monograms.

F

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or sketch, the monogram on the watch-case, and point it in, in doing so correcting any small detail in the design and being careful not to make marks except those to be cut away with the graver. Then with a lozenge graver, well sharpened and polished as before described, outline the monogram, preserving the same depth of cut throughout. Cut the hair-lines, if any, in the interior of the letters, and then the fine horizontal or diagonal lines, called "colouring"; this colouring is formed of a number of lines side by side of equal depth and distance from each other, leaving a perceptible space of the surface of the metal uncut. Next thicken all the letters, but chiefly those of the right-hand side; ornament the principal letter of the group; shade the parts of the letters where the entwining takes place, and carefully finish all sharp points of the monogram. Then take a print of the engraving for future use, clean up the work with a piece of raw indiarubber, and the job is done. Much care is necessary to prevent the watch-glass being scratched or broken, and the use of a 2 in. extra soft sand-bag or of a chamois leather over an ordinary sand-bag is advised.

Ciphers, as a rule, are difficult characters for a beginner to execute, the tendency being towards an ungraceful leaning to the right hand when sketching them in. Ciphers may be plain, ornamental, or grotesque, and may be used singly or in combination, as for a monogram. Ciphers may be employed on various materials, as, for instance, for inscriptions on gold and silver plate, forks, spoons, the ivory and pearl handles of table and dessert knives, the small shields of watch-cases, and, under the better known title of script, may be introduced wherever the good taste of the engraver may suggest.

A totally different job from any of the foregoing is to engrave on a pair of ivory-backed brushes a monogram of four 2 in. letters. For this work is neces-

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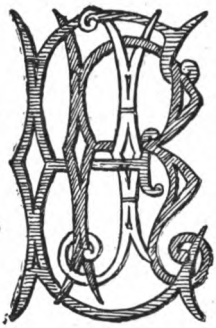
Fig. 76. HR

MOT
Fig. 77.



JRE
Fig. 78.

GSM
Fig. 79.

Fig. 80.
KK

Fig. 81. ADB

Fig. 82. HTB

VGA
Fig. 83.

Fig. 84.
JM

Figs. 76 to 84.—Monograms.

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sary a pair of clams made of moderately soft wood. These preserve the whiteness of the bristles and hold the brush firmly. To make a pair of clams, have the face of a piece of pine, 7 in. by 5 in. and 2 in. thick, recessed on an oval lathe to receive the oval brush, with an inside ledge on which the ivory back will rest; the recess should be sufficiently deep to avoid the bristles touching the bottom. Taper off each end at the sides so that an ordinary 3 in. wood screw will go right through, and recess a portion of the face of the block for the handle (if any) of the brush to lie in. Rule a line down the centre of the face of the block, and saw down this line until the block is in halves. Put in the screws at each end, so that the two halves are held together closely; put in the brush, bristles downwards, tighten up the screws, and then the brush will be held as in a portable vice.

The engraver often has to work on ivory, and its substitute xylonite or celluloid, and pearl; as regards ivory, the engraver needs to be on his guard against the run of the grain. A peculiarly light yet firm hand is necessary for this work, the tools and methods being the same as for metal; keep the tools very sharp. The engraving when finished is filled with a solution of best black sealing-wax, with which a pinch of powdered Prussian blue has been thoroughly mixed, and the whole dissolved in proof spirit of wine till of a thick creamy consistency; the solution is kept in a glass-stoppered bottle so as to prevent evaporation. The method of applying is to fill the cuts, taking off the excess of ink from the surface of the engraved article and laying aside to set. Afterwards the surface of the ivory is dollied in a lathe, the polishing medium being a little whiting. If a number of knife-handles are to be finished, rig up a small lathe carrying a linen polishing dolly, made by cutting out into circles, from 6 in. to 12 in. in diameter, fifty or more linen sheets, and screwing

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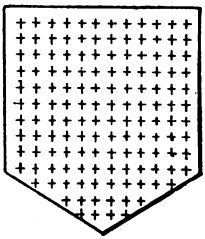
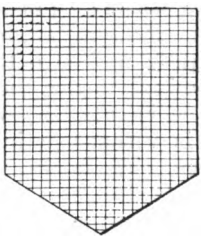


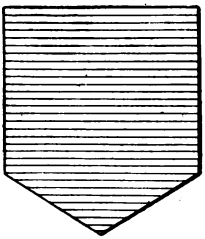
Ash Grey.

Fig. 85.



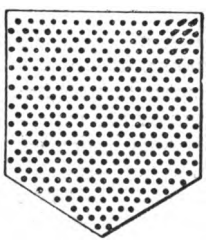
Black.

Fig. 86.



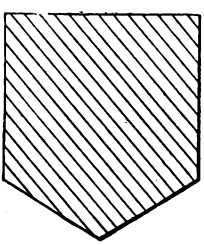
Blue.

Fig. 87.



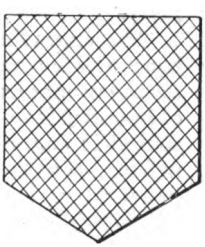
Gold.

Fig. 88.



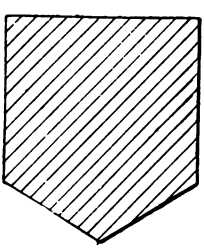
Green.

Fig. 89.



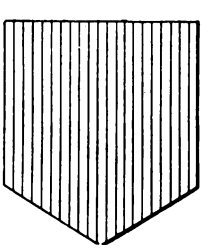
Murrey.

Fig. 90.



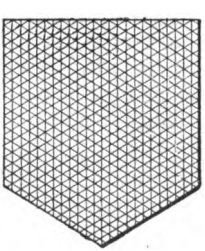
Purple.

Fig. 91.



Red.

Fig. 92.



Tawny.

Fig. 93.

Figs. 85 to 93.—Heraldic Colours.

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them tightly in the centre on a mandril. The speed of the lathe causes these to become erect, and the ivory handle is lightly applied as the dolly revolves, aided by a little whiting to grip the superfluous wax on the surface of the handle. Xylonite, or celluloid, cuts easily, and is without grain. Pearl is more difficult to cut, and quickly wears away the point of the graver. Pearl also has what may be called a grain, and it may be more easily cut in one direction than another. However, it is possible by practice for very excellent work to be done on pearl, notwithstanding its disagreeable rasping cut. Engraved xylonite and pearl are blackened in the same way as ivory.

The engraving of heraldic symbols, crests, etc., has much in common with monogram engraving, but for the proper execution of the work some knowledge of heraldry is necessary. Heraldic colours are represented in engravings by lines and dots as indicated in Figs. 85 to 93, p. 85. For white or silver ("argent") in heraldry, the surface is left quite plain. Gold has the heraldic name of "or," and is represented by dots (Fig. 88); red is "gules," and is represented by vertical lines (Fig. 92); blue ("azure") by horizontal lines (Fig. 87); black ("sable") by vertical and horizontal lines crossed (Fig. 86); green ("vert") by diagonal lines (Fig. 89); purple ("purpure") by diagonal lines in the opposite direction to green (Fig. 91); ash grey is indicated by little crosses as in Fig. 85; murrey by cross-hatching as in Fig. 90; and tawny as in Fig. 93.

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CHAPTER VI

ENGRAVING STEEL FOR TRANSFER PROCESSES.

THE process of ornamenting the surface of metals by means of transfer originated in the demand for the multiplication of intricate and involved designs which could not be reproduced by ordinary hand engraving except at a prohibitive cost. This form of transfer engraving belongs to the highest and most artistic class of work, and a few facts as to its origin and development will be of interest. Siderography, or the art of engraving by duplication of transfer, was invented many years ago for the purpose of rendering the counterfeiting of banknotes and other valuable paper well-nigh impossible. It was the outcome of the inventive genius of two workmen who came from the United States of America, in the year 1819, to compete for the premium of £20,000 offered by the Bank of England authorities. These men were Jacob Perkins and Gideon Fairman, the first having the honour of the invention of the press for producing duplications of transfer, and the latter being at the time a celebrated banknote engraver. As for the result of the competition, it is said that Messrs. Perkins and Fairman were unsuccessful in their attempts to produce a banknote which could not be counterfeited, but the Bank of England authorities gave them the handsome sum of £5,000 for their ingenuity and trouble. The Bank of England still continues to produce their notes in the old way, depending chiefly upon their specially made paper for protection, and from time to time the public is startled with the news of another gigantic forgery. Perhaps at some future time some person will convince the directors that they are be-

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hind the age, and induce them to make the commonplace banknotes more artistic in appearance, and less liable to be counterfeited.

The leading features of the art of siderography, or duplication of transfer, are the rapidity of printing a series of banknotes at very short notice and the method of consecutive numbering whereby, say, No. 1 and No. 500,000 are exactly alike, except for the numbers and distinctive letters. In addition to the above advantages, several artists may be employed in the production of a single plate. Thus one engraver specially skilled in that branch may be employed on the ornaments for the corners, another on the portrait or coat-of-arms, a third on the lettering, a fourth on the geometric engraving, a fifth in arranging the whole in an approved design, and finally the transferrer will manipulate the various portions of plates to form the resulting complete plate from which the notes are eventually printed. The advantages of the method are that should a forgery be discovered in a series in circulation it may be cancelled immediately, and a fresh series with a different design may be produced from the existing plates, and a re-issue printed.

The expense involved in the manufacture of banknotes may be inferred from the following list of a few of the appliances required, foremost of which is the modern banknote engraver's transfer press. This was an American invention, now considerably improved upon and patented, and its cost may be estimated roughly at £350. An accurate surfacing lathe, with accessories, is also requisite in the transferrer's workroom, and a furnace and implements for hardening and tempering; the cost of these would probably amount to £100. The most costly item on the list is the geometric engraving lathe, costing from £1,050 to £1,500, supplemented by the cost of the usual tools required for doing the work. Next come the highly finished, almost self-acting copper- and

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steel-plate printing machines. A staff of steel engravers suitable for the work in hand would be required, whose salaries would amount to £60 weekly, and the transferrer and geometrical engraver would divide £12 weekly between them. The cost of the stock of paper necessary for the successful carrying on of the business of a banknote engraver and printer is also a large item.

In the general fit up of the workshops of engravers on steel not much difference is observed from that of the ordinary engravers, except that the room is extremely well lighted, being usually at the top of the building and having the advantage of the front and side lights as well as of those in the roof. Six or seven engravers are at work on as many steel plates. The tools used are not very different from those of an ordinary engraver. Perhaps what most strikes the observer is the extreme care with which the engraver on steel does his work. There is, indeed, a great necessity for this, as a false cut may very easily spoil a week's work.

An endeavour will now be made to give the reader an idea of the cheap and effective manner in which electro-plated Britannia metal tea and coffee services, etc., are decorated by means of re-rolling the metal on an ornamented steel plate. This is the popular method of enriching sheet metal in a cheap and effective manner by re-rolling it in contact with a brass or steel plate which has previously been engraved, chased, or engine-turned in the required design. The two are then passed between a pair of rolls, the softer plate receiving the impression from the harder one. The rolls require to be managed by an experienced person who knows the exact amount of pressure required to bring out a good design. Brass plates for re-rolling Britannia metal are the least expensive, more easily worked, and last the shortest time; but still, in the hands of a skilful roller, will do good work. Brass plates

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are not much used, partly because the plate spreads by the action of continued rolling, and partly because they are sometimes spoilt by damage sustained when sent to be rolled at a public mill, when this is necessary through not having proper rolls at home. Steel plates will give a clean impression of the lightest cut on Britannia metal, brass, and also on German silver if the precaution be taken of first annealing the metal to be re-rolled, but the steel plates are expensive.

The production of engraved steel plates for rolling Britannia metal and other soft alloys is a branch of the general engraver's work, though probably it is usually done by specialists. These plates require to be very hard, so that the design engraved on them is clearly reproduced on the soft metallic alloy, which afterwards is spun or otherwise formed into teapots, cups, and miscellaneous articles. Thus these plates are of use only for repetition work of a cheap kind.

Steel engraving for purely commercial purposes is an art that has been greatly developed of late years. It is about the most highly-paid branch of engraving, excepting, of course, the more artistic work of banknote plate and wood engraving. Many years of constant practice are necessary to attain proficiency in the work.

Before steel engraving was taken up to fulfil the requirements of commercial enterprise, very crude effects were produced by the hammer and chisel. The first attempts were on plates of 1 in. in thickness, but these were clumsy to handle, and were costly, and so the thickness was decreased to ¼ in., at which it remains.

The preliminary preparation of steel plates to be engraved for re-rolling metals will be found difficult work without proper tools and experience. The beginner is advised to buy of the manufacturers, who will supply any sized plate required,

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and in four different kinds of temper, which are generally distinguished by the following marks: S, very fine and soft steel; M, very fine and medium softness; R, fine hard steel, which will cut nicely with the graver; EH, extra hard steel.

The prices of steel plates vary with the size, thickness, and strength. A plate of less than 100 superficial inches, and of the ordinary strength, which may be from $\frac{1}{8}$ in. to $\frac{1}{4}$ in., according to the work to be re-rolled, is approximately 1½d. per inch; from 100 in. and less than 200 in., 1½d. per inch; larger sizes, from 200 in. to 2,500 in., from 1¾d. to 5d. per inch. The edges of the plates are usually bevelled to facilitate their entrance between the rolls. The surfaces require to be perfectly flat and of equal thickness, because if the surface be uneven the design may be reproduced on one part of the metal while the impression may be very faint or not reproduced at all on another part; it must also be free from scratches, as every mark on the plate will be reproduced, which in case of a slip of the graver is most undesirable. To give an idea of the power of a pair of rolls properly adjusted in contact, it may be stated that a sheet of writing-paper placed on a piece of Britannia metal and passed between the rolls at the proper pressure, would transfer the water-marks of the paper on the sheet of metal, where they would be clearly visible.

The tools for engraving steel do not greatly differ in shape from ordinary gravers, but their temper must be suitable to the work. A very hard graver is useless, as its point would break off at every cut, whilst that of a soft graver would rub away at once. A medium degree of hardness is obtained by heating the graver in a very small gas jet to a light brown colour, and cooling it immediately in water. Even with this tempering the edge will not last long. Gravers for steel are lining gravers chiefly, and two or three sizes of round-nosed tools, no other kinds.

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The texture of a plate of steel—even of the softest obtainable—is very dense, and is unlike that of any other metal, except, perhaps, gold. Owing to this, the belly of the graver must be set at an obtuse angle, and the back at an acute angle (say 45°). If the belly were acute-angled, more force would be required to make a cut, and if the cut were deep the point would be broken off, and remain embedded in the incised line, rendering it difficult, if not impossible, for the cut to be continued forward with another graver. The only way out of such a difficulty is to re-start the cut from the opposite direction, when probably the broken-off point will be lifted out of the cut by the chip of steel.

For sharpening the tools, three stones are employed, namely, a 12-in. or other handy grindstone, to work either by hand or treadle; a Turkey oil-stone; and an Arkansas oil-stone. On the grindstone are ground the backs of the gravers when they become thick and blunt at the cutting end; the Turkey stone is used for whetting the facets of the belly, and the Arkansas oil-stone for whetting and renewing the point from the back of the graver. The Arkansas stone renews the angle of the back of the graver without throwing up any fash or burr. For full information on whetting and sharpening gravers consult Chapter II. Four sandbags are required, of 14 in., 10 in., 6 in., and 4 in. in diameter respectively, to support the plate while being engraved. Illustrations of sandbags are given on p. 28.

At least two dozen gravers should be ready for use when engraving steel; six, at the most, may conveniently be in use on one job, say two for outlining, two for finishing, and two sizes of round-nose tools for forming "spots," and for "wriggling" in already engraved lines.

A burnisher of medium size will be found useful for rubbing down scratches on the steel plate, which must always be burnished in the long direction of the

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scratch. An oval burnisher is illustrated by Fig. 30, p. 35. These burnishers, with tracing point, spring dividers, 12-in. compasses, straightedge or tee-square, oilcan and oil, turpentine, pencil, paper, and indiarubber, letterpress printing ink for transfers and ordinary black prints, complete the outfit.

A few general suggestions may be of value to the steel engraver. The beginner should get a little training, otherwise the thumb and first finger of the right hand may become numbed by the tight grasp of the graver, and it is not wise to overtax the strength. The plate should be slightly warm, but not so hot that it cannot be handled comfortably. If the gravers are thin at the cutting end, time will be saved in re-whetting; the occasional use of the grindstone is beneficial. Soft whetstones require a good deal of attention; a rub down weekly on a sheet of No. 2½ emery cloth will keep them in good condition. Keep all gravers sharp, and see that each is of the correct temper. The gravers should be sharpened at the greatest set-off that is convenient, especially those for outlining curves; but for straight lines, the set-off is not so great. Before putting the plate away after work, it should be greased to prevent it rusting, for which purpose the thick oil from the oil-stone answers very well.

The ornamentation of steel plates requires practical knowledge, especially in the setting out of the plate for the size and shape of the article which is afterwards to be formed, either in the spinning lathe or by the process of stamping. The usual way of defining the outline, or cutting-out line, of the shape of the article to be made from the re-rolled metal is by means of a template. The manufacturer of the articles ornamented by the re-rolling process keeps the templates of different shapes and sizes for every article made. To make these templates great care is necessary, as if the outline is not in accordance with the desired shape

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of the article the engraved design will not come out properly when transferred to the metal. The arrangement of the design might look correct on the plate, but when made up irregularities might appear. The manufacturer will supply a facsimile of the particular template; or, more commonly, the steel plate will be sent to have the cutting-out line marked with a sharp tracing point or etching needle from the original template.

The first process in engraving a steel plate is to set out the line within which the design is to be executed. For this purpose the template is used. Suppose the steel plate is required for rolling ¼-in. metal to be made up into teapots, the extreme size of the metal for each teapot being about 18 in. by 6 in. The template is laid upon the plate in a central position, and scored round with a steel scriber or tracing point. This would give the "cutting-out" line, which encloses the ornament, and from which all measurements are taken. This cutting-out line is then cut, a moderate pressure being used in ploughing up the cut. This line is, of course, repeated on the soft metal when rolling, and of course limited to the area of sheet metal made up into each article. The template is curved at the top and bottom, and has accurately bisected angles at the sides. The whole truthfulness of the work depends on the accuracy of the cutting-out line, and this is now divided into equal parts, so that the ornamental work can be spaced out so as to show truly on both sides of the finished teapot. With the large compasses in the right top angle, and having as radius any distance more than half the length of the plate, strike a short curve on the plate. Repeat from the other top corner, and also from the two lower corners. Draw a line through the intersecting points of the two top and the bottom curves. This line must be perfectly central, and should be tested before proceeding further. This done, the

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space on each side of the central line must be divided in like manner, and on the two lines thus obtained will rest the centres of the shields. Prove these lines by going over the measurements again.

Any ornamental border, if, as is usually the case, enclosed between double lines, must follow the outlines of the top and bottom curves. The easiest way of setting out the border lines is to take a pair of stiff spring dividers with sharp points, and, placing one leg in the engraved line, draw the dividers along, allowing the other point to trace a line parallel to the outside one. This should be done as soon as the divisional lines of the work have been ruled, when the border may be sketched in at once with the tracing point. As these borders are merely a repetition of a given ornament, it will be necessary to step out with the spring dividers, starting from the central line of the plate, and working to the right and left hands until within ½ in. of the outside angles, and there finish off the parallel lines with a plain curve, or other ornamental finish consistent with the character of the design. The reason for this stopping short of the borders is that the rolled metal has a soldered seam on that part corresponding to the outside angles of the plate; and the space on either side, which becomes 1 in. wide when the seam is made, allows for soldering, hammering, and buffing without damaging the ornamental work.

A stranger to this kind of work will find it best to have a model of the Britannia metal teapot it is proposed to ornament spun in the lathe to the required size, without either the lid or bottom. Take a pair of shears and cut a true line down the seam or soldering place of the spun body piece, and pull it as flat as possible, finishing by means of a flat iron—not too hot—on a level piece of wood. This will be the template for forming the boundary or cutting-out line on the steel plate. The cutting-out line being marked on the plate, lay down the tracing on the

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wax, placing a piece of paper over it, and rub down the tracing with a smooth ivory rubber, taking care that the impression is clear in every part. If the pattern is a repetition of sections, lay down the pattern on each of the lines required to produce a continuous whole.

Fig. 94 represents the steel plate as it comes to the engraver ready for him to work upon, and it is covered with a film of white wax on the face to prevent rust, to which the polished surface is highly susceptible. The engraver will prepare the design on a sheet of tracing-paper, or may sketch the pattern on the steel; or, if the design is a repetition in sections, the plate is divided very carefully, taking great care that the lines run true radially from the centre, B, B. If there is no visible centre, as in the case of a hollow article, such as a teapot, the centre of the side template lines at the top and bottom must first be got with the greatest accuracy, and a line ruled with an F lead-pencil; this will divide the distance between the side template lines, and will give the point opposite to the seam or join when the article is soldered. This being done, rule two more lines (C C and C C), on which the shields and surrounding ornaments are placed. When making a pattern for this class of work it is desirable to know what shape the article is to take, especially if it is to be spun in the lathe, so that the work of the spinner may be done quickly and without unduly damaging the ornamental work on the article. The engraver should have some knowledge of spinning metal in the lathe, and know where the steel burnisher is used and where the soft wood is used. This will have to be studied in a shaped article, and necessary provision made for the proper distribution of the ornamental work. In Fig. 94, D E F G shows the template lines for cutting out after the metal has received its ornament.

When the top and bottom borders are drawn in

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with the tracing point, the body of the ornament may be attempted. Copy one half of the pattern with a lead pencil upon the plate, taking care not to encroach on the ½-in. limit at the side. When this has been accurately drawn, trace in with the steel point. If the pattern has been properly drawn in pencil on paper, cut this into halves and rub down on a film of white wax or beeswax previously melted on the plate while warm.

With a keen graver outline the half section with a light cut, acquiring greater depth the second and third times of re-cutting, as this work requires a

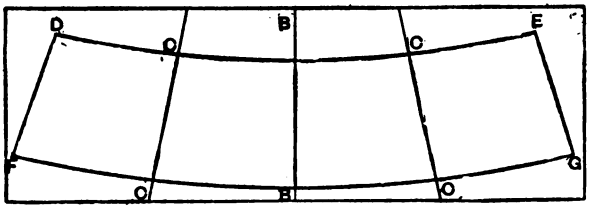

Fig. 94.—Steel Plate set out.

deep cut. Each curve or line may, however, be re-cut while in position, the principal object being to secure uniformity in depth of cut.

In many cases the design of such a piece of work will be a repetition of the half section reversed, and joined together on the sectional line, forming the complete design of one side of the teapot. To obtain the full section of the ornament, take a black print as described on p. 57, and rub this down on a piece of damp paper, using this second print from which to rub down the reversed design in the place where it is wanted. The designs are now pointed in with the tracing point, and afterwards cut with the graver as before advised. When the whole of the section is outlined, another black print may be

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taken and laid down on the other sectional line, having strict regard to the height of the ornament in the other section.

With regard to hair-lining, shading, and finishing, little can be said here, as so much depends on the style of ornament selected for the enrichment of the plate. Few styles look better than the ordinary scroll, interspersed with floral ornament. And in the case of scroll-work, a portion—not too much—of the groundwork should be either blacked out, or chequered, or cross-hatched. Both these processes are difficult to do well on steel by hand, and should therefore be done by machine. In the shading of the scrolls, cross-shading is quite inadmissible, as it looks ineffective when re-rolled; therefore, the scroll-heads and leaves are better shaded so that the shading runs in a line with the contour of the ornament, the remainder of the hair lines and thickening cuts, and the general finish of the work, being the same as for silver engraving.

In the engraving of the lines of the top and bottom borders, the two lines between which the ornamental work is to be engraved should be cut quite lightly. These light lines render the work of cutting the ornament more easy than if they were deeply cut, as the tendency of the graver is to fall into the deeper cuts when turning a scroll-head or other rounded ornament; these lines may be deepened afterwards. The outermost lines may be engraved as boldly as the mass of ornament in the centre of the plate.

Dependent upon the nature of the metal to be rolled, the engraved plate may or may not require to be hardened, and subsequently tempered. For hardening the plate, an iron box with close-fitting lid or its equivalent, a supply of ivory dust or ivory turnings, and a forge fire supplied with bellows must be obtained. The engraved plate first is put into a warm place to "sweat" out the moisture, any damp-

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ness being carefully wiped away. Then place the ivory dust in the box, and blow up the fire until the dust is converted into charcoal, frequently stirring up the contents of the box to get rid of even a trace of dampness. Now put the plates in the box with a layer of charcoal, and ram down tightly, the object being to exclude all air from the plates. They may be placed in tiers, with layers of charcoal between them. The box must of course be of a size to accommodate the work to be hardened. The charged box is put into the middle of the fire, the coke heaped around it, and the fire blown up until the box shows an equal red heat all over the outside, when presumably the plates inside the box are at the same cherry-red heat. But this is one of those points where great experience is required, because if the box is overheated the engraved plates are quite spoiled; and if underheated the ivory dust is wasted, and the whole process has to be repeated. But assuming that so far all is successful, take off the lid, and plunge the box and its contents into a large cistern of cold water.

Now comes the tempering of the plate. While the box is cooling in the cistern of water, heat a thick iron plate in the fire. By the time this is heated the box in the water will be ready to handle. Take out the engraved plate, and wipe it dry. To temper it, take the plate of iron out of the fire, place the plate fairly upon it, and watch in a good light for any change of colour. The colour of its temper will depend very much upon the nature of the work for which the plate is to be used.

Assuming that hardening and tempering have not been necessary, clean the engraved plate with turpentine and rags, and deliver it in a bright state to the roller, who has sheet metal ready to try the plate. The following directions are invariably given for the first rolling of a steel plate. Place the plate between two sheets of

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metal, and pass the three through the rolls with sufficient pressure to bend the plate, thus "bedding" the plate to the form of the rolls. The plate must afterwards go through the rolls in the same direction; and to indicate the proper direction an arrow is engraved or chased on some plain portion of the plate (as shown in Fig. 95). The steel plate having taken the form of the rolls, these are readjusted, and another sheet of metal is placed on the face of the plate and passed through. It is received on the other side by an attendant, who passes it over to the head roller, who examines the impression to see if the pressure is sufficient. If the metal buckles in the course of rolling, the rolls have been screwed down too tight. If the impression is faint, more pressure is required. An experienced roller will generally get a good impression on the second or third sheet of metal; he must not use the same sheet of metal twice, as the metal is somewhat thinned in its passage through the rolls. The roller having tested the trial plate, and found it perfect, will proceed to roll as many sheets as are required, these having previously been cut out to the size of the plate.

Every plate to be used in re-rolling metal must be square or oblong. The size of the plates may vary from 6 in. by 6 in. to 36 in. by 24 in. The rolls used for this purpose are about 36 in. by 12 in., the surfaces being dressed quite smooth, and they run at a very moderate speed. The rolling is mostly done on the manufacturer's premises, but may also be done at public rolling mills.

In preparing a steel plate for rolling a round salver or waiter, an allowance must be made for the bending of the plate during its passage through the rolls. If a circle is struck on a plate and then rolled, the impression will be elongated and show an ellipse, which, on being struck into shape by the action of a round die, would leave an irregular distance between

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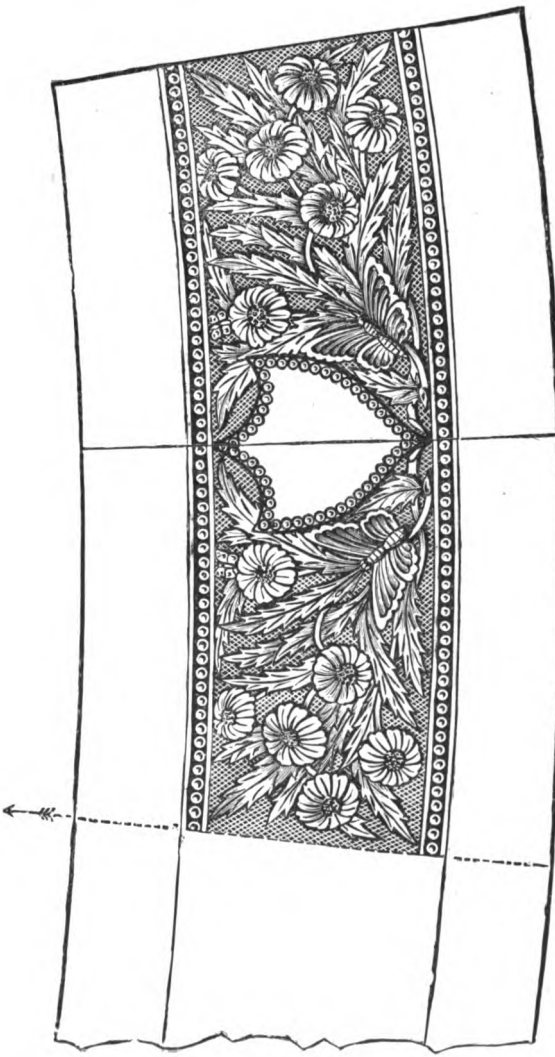

Fig. 95.—Engraved Steel Plate

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the ornamental work and the margin of the swage of the waiter. To obviate this, and make the ornament to correspond with the circular outline of the bed or flat part of the waiter, an oval figure must be truly formed on the plate, the minor axis of which must be presented to the entrance of the rolls, as shown in Fig. 96, where B B shows cutting-out line after re-rolling; C C, circular dotted line showing figure of the ellipse required to counteract the bending of the plate to the curve of the rolls; and D D, boundary line inside which the ornament must be placed. The arrow indicates the direction in which the plate must go through the rolls.

A simpler way of explaining the matter would be by figures, thus: The bed of a 12 in. waiter would be, say, 10 in. in diameter; and it is wished to leave a margin of ½ in. between the ornament and the swage, thus reducing the space to be ornamented to 9 in.; therefore a true ellipse of 9 in. by 8¾ in. would, when rolled in the direction of its minor axis, produce in the impression a circle, and so correspond with the circular die in which it is to be struck to the required form.

In stamping a sheet of metal to make a salver, a sheet of stout brown paper is placed between the ornament and the bed of the die, which effectually protects the ornament from being damaged by the contact of the upper die or "force." In setting out the plates for oval salvers and trays, a similar precaution is adopted in making the elliptical figure longer than that to be produced on the rolled sheet by presenting the minor axis of the ellipse to the entrance of the rolls.

It will be seen on reference to Fig. 95 that the top and bottom lines and the outlines enclosing the floral ornament are segments of circles. These lines should be cut in a lathe, preferably a rose-engine lathe, the bed of which has a gap of sufficient depth to allow the steel plate to swing after having

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been properly centred, and also of sufficient width for the oval chuck to be used for work larger than 16 in. diameter. This 16 in. in diameter on a square plate would be equivalent to nearly 19 in. on account of the projecting corners. The rings of beads shown are cut by an eccentric cutting frame or drilling spindle, with a cutter having the point slightly rounded off on the oilstone after being sharpened in

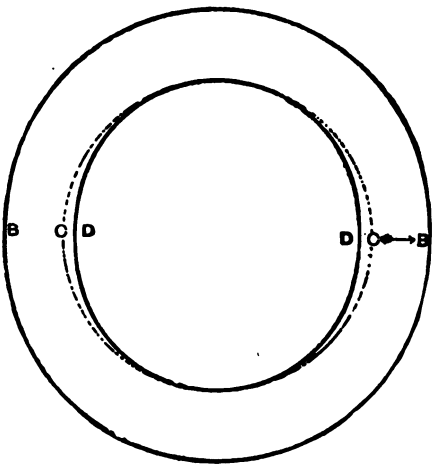

Fig. 96.—Steel Plate for Circular Waiter.

the goniometer. A high number of divisions on the division-plate will be required for the rings—probably as many as 720. The beads inside the shield are done in a similar manner, but, owing to the irregular outline, no guide is possible, and ingenuity must be employed to make the job easy. When the beads in the segments are done, remove the plate from the lathe and fix it in any of the well-known ways with the shield as near the centre of the chuck as possible. Now screw on the lathe the straight

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line chuck, and in this fix the chuck on which the plate is fixed, and get it vertical with the corners, A B, of the shield, Fig. 97. See that the slide-rest is parallel with the work, sharpen the cutter, and turn back the drilling spindle to the bottom of the shield and cut the first bead. Take a number of divisions on the slide-rest, so as to allow each bead to barely touch the next, and turn the lathe by means of the hand slightly upwards, and cut the second bead. Now, without taking any slide-rest divisions, turn the lathe downwards till just near enough the outline to cut the third bead; then take the same number of slide-rest divisions and cut the fourth and

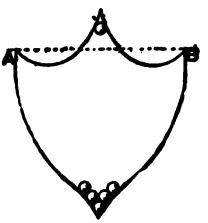

Fig. 97.—Diagram of Shield on Steel Plate.

fifth beads; and so on till the outline of the shield is filled up, finishing with a single bead at the top of the shield.

The groundwork of the design (Fig. 95) may be matted by a chaser, cut away in consecutive lines, blacked out, coloured, or finely chequered by the engraver, or filled in with a suitable fine pattern by means of the rose-engine.

Embossing or chasing by transfer is an interesting process, very rapid compared to handwork, but being very expensive is considered to be a commercial success only where large numbers of one size and pattern can be made and sold. The process is applied only to Britannia-metal goods. The shape of

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the article being decided upon, a model of the body is spun in the lathe and a hollow mould is turned in soft steel to fit the model. This steel mould is then sawn into four equal parts (Figs. 98 and 99); both the turning and sawing are carefully executed, and a solid iron ring (Fig. 100) made to fit tightly on the outside of the hollow mould to keep the sections in their respective places. These sections are numbered at the top or in some prominent place—1, 2, 3,

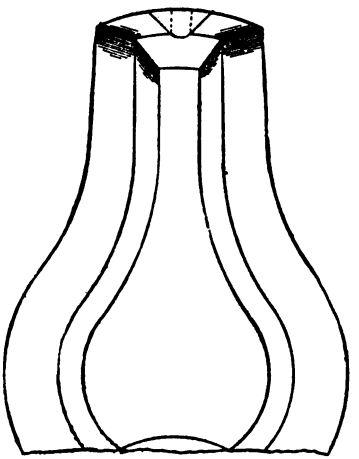

Fig. 98.—Three Sections of Steel Die for Embossing Coffee Pots.

and 4—so that they may be identified at a glance. The mould then goes to the die-sinker, who cuts a previously accepted design, preferably a pattern in four sections, but not necessarily so. The mould, having received its ornamentation, is then hardened and tempered, after which it receives its final polish, and is then ready for the operation of transferring its design to the body of the article to be embossed. The plain bodies of the articles are first spun to

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shape in the lathe, without bottoms, in quantities as may be required. The steel mould is then warmed in a furnace constructed for the purpose, and taken to a convenient bench, where it is opened and cleaned if required, and one of the spun bodies is placed in it. The mould is now taken to an adjacent hydraulic press constructed for the purpose, attached to which are pumps. These pumps are now

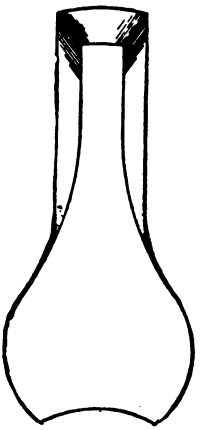

Fig. 99.—Fourth Section of Steel Die for Embossing Coffee Pots.

put into operation, and the interior of the spun body filled with cold water. The time taken in this operation causes the water to become slightly warm, and the heat of the mould renders the metal quite soft. The interior of the article being full of water, hydraulic pressure is continued till, in the judgment of the directing workman, the metal has taken the form of the ornament cut on the interior surface of the mould; the pressure is then discontinued and the water let off. The operations are repeated until the

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whole series of spun bodies are embossed, which if skilfully done present all the appearance of hand-work.

Another method of transfer applied to the softer metals is by casting, but it is not quite satisfactory, as the casting develops pin-holes, rendering needful a particular alloy that shall run freely. This is a secret in the hands of a few, and the specimens of work to be seen are not well done, they frequently having to be touched up by hand.

In producing cast work an article is engraved by hand, after which a plaster-of-paris cast is taken in

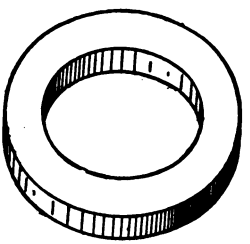

Fig. 100.—Iron Ring for Clamping Die.

two halves; these are properly fitted together so as to form one complete whole. A plain core is placed within, leaving a narrow space in which is poured the molten metal, made specially to run freely. Great caution is necessary to have the plaster casts perfectly dry, otherwise a serious accident may follow. In the case of an article whose two sides are alike a cast is taken of one side only, and two such impressions are soldered together to form one complete article.

Another mode of transfer applied to flat or plane work, such as a salver, is by means of a circular flat steel die engraved or chased, and mounted on a chuck in the spinning-lathe. The sheet of metal to

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be ornamented is then held in position by the back-centre, the lathe revolved, and by a steel burnisher the metal is forced into the engraved pattern, thus transferring the design to the metal. Another method of transfer has been patented, and by it may be reproduced rapidly and cheaply any design in etching, chasing, or engraving. First, a steel plate is chased or engraved with the desired subject; the plate is then hardened and tempered, and another steel plate, hard from the rolls, with its surface polished, is placed on the hardened plate and passed through the rolls with sufficient pressure to reproduce the design in relief. This second plate is used for re-rolling the metal in the manner before described on p. 100, reproducing the design in intaglio. This renders the ornamental work as easy of finish as if it were done by hand.

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CHAPTER VII.

ENGRAVING NAME-PLATES.

NAME-PLATES are made of brass, nickel, German silver, and phosphor-bronze, brass being the cheapest and most common, but the last-named three being the more durable. The instructions given in this chapter relate equally to brass and the other metals mentioned. Name-plates up to 16 in. by 12 in. in size are $\frac{1}{8}$ in. thick, plates of larger size and for superior work being $\frac{3}{16}$ in. thick. The plate is cut to size where it is bought, the size being set out on the sheet, which is scored deeply with a scriber, and then cut square with a heavy pair of metal shears. Brass and other metal plates are sold by weight.

Name-plate engraving is executed in two ways: for small and moderate-sized work the graver is used in the usual manner, and for large work the hammer (Fig. 27, p. 34) and chisel are used (see Fig. 24). The chisel removes the metal in a very short time, but the great noise made in the operation renders the process unfit for home work. Chiefly owing to this noise many engravers prefer to cut the whole with the graver, and though this takes a longer time more correct work can be done.

It is shown on p. 24 that a name-plate engraver's output includes certain tools not required by the ordinary engraver, and possibly some workmen may have tools by them which by a little ingenuity can be utilised for name-plate engraving.

Brass plates as obtained from the metal dealers require to have their faces trued up, and this work can be done only by expert hammerers; an inex-

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perienced man will cover the plates with hammer marks, which will give great trouble to remove. For flattening the plates a flat steel stake should be obtained, about 2 in. in diameter and firmly fixed in a wooden block; a silversmith's flat hammer and a straightedge also are necessary. Place the plate upon the stake, and, beginning at the outside edge, work towards the centre, trying now and then the truth of the plate with the straightedge. Great judgment must be exercised as to the general condition of the plate before hammering, as it often happens that a few blows in the right places will true a plate in the course of a few minutes. Another method is to use a pair of heavy planishers, screwed up in a heavy vice, and these greatly simplify the work. When the plate is flat, put it between lead clams in a vice, and with a 12 in. flat safe-edge file, kept for brass work alone, not too coarse a cut, true up the edges, and bevel if desired. The flattened plate then is rough polished on one side only, previously being smoothed with a dead smooth file. For rough-polishing, have a big piece of pumice-stone and plenty of water, and rub the plate always in the same direction evenly all over the surface till every scratch is removed. Finish by rubbing with a piece of water of Ayr stone and with water until a fairly smooth surface is obtained, and all deep dents, hammer marks, and scratches are removed. The plate is now in a fit state for engraving; but if the filling in the engraved letters is to be of wax ground up with gold size, or other pigment which has to set hard by exposure to the air, the plate must have a fine face put on it by means of a Tam-o'-Shanter hone.

The lettering on door plates should be in a simple style and very legible; perhaps the most suitable styles are block letters and the Italian, or script. Ornate and elaborate plates do not answer their purpose; for instance, in one case a plate done in

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three styles was found most difficult to read: the name was ornamented Roman, the middle line in German text with flourishes, and the bottom line in Gothic lettering.

The chisels for lettering in brass are ground wider on the cutting face than on the back, for clearance. After grinding down to the required width, the edge is finished on the oilstone, the flat face being slightly set off. This chisel for straight lines must be carefully whetted flat and true, or it will cut all awry. In commencing the cut, place the right-hand side of the chisel on the ruled line and strike a few light blows with the hammer, when, having ascertained the correct depth, proceed by chipping out short lengths at a time, releasing the chip at intervals so that the line can be seen clearly. This is the ordinary process, but an easier method is to rule double lines with dividers and cut each line with a lozenge chisel, afterwards cutting away the centre with a flat chisel.

The plate may perhaps require border lines, with or without ornamental corners, and these should now be done; the lines are cut rather deeply so as to hold the wax filling. Set out the lines by scoring the edges with a pair of dividers, set at from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. from the edge, according to the size of the plate. Then draw in the ornamental corner, outline it, take a print, lay down the opposite corner, then transfer and lay down the other corners, and mark in with a tracing point. Flat chisels may be used for cutting the border. The centre of the ornament should come just where the countersunk hole for the screw is intended to be. The border lines being cut, the holes for the screws may be drilled with a breast-drill and then countersunk for the screw heads; countersinking is not necessary if round-headed brass bolts are to be used. If the plate is to be put on a door, two bolts must be soldered on the back, and these will, by means of nuts, secure the plate on the inside of the door.

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These bolts are soldered on after the plate is engraved, but before the letters are filled.

The inscription may be set out with pen and ink or pencil; the former is the quicker method, as it saves printing or scratching in with the tracing point. The inscription always is drawn in between straight or curved parallel lines, which should be lightly marked with the point or with compasses. Perpendicular and other double lines should be ruled with the dividers, first cutting one line, and ruling the other by placing one leg of the dividers in the cut and drawing them along. This secures uniformity of width in the plainer letterings, such as block, Roman, and Egyptian. It is a good plan to pencil a line down the centre of the plate, and also one across the centre of the plate; then count how many letters are contained in the name, and roughly sketch in the centre letter of the top line midway between as shown by the centre pencil line. Continue to roughly sketch in the remaining letters each side of the centre until they are pretty evenly balanced. Now rule with the straightedge and point a line at the top and bottom of the roughly sketched-in name, and proceed to draw carefully the whole name, seeing that each letter has plenty of room to stand in, and that the name itself is well balanced on the plate.

The set-out plate can now be pointed in. Use the rule for all straight and angular lines, and the dividers and rule for parallel lines, and keep the block letters upright, and the script at a moderate angle.

The pointed-in plate now is ready to be mounted on the stone with cement. Before pouring the hot cement on the stone, brush off all the dust and sand that may be adhering to it, and place it before the fire to be thoroughly warmed through; then warm the plate, and lay it on the hot cement, pressing it down so as to make it solid to work upon. This

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will deaden the sound of the hammering, and resting the stone on the large sandbag will further deaden the sound, counteract the effect of the blows on the chisel, and enable the engraver to turn the work in any required direction (see Fig. 101). Various devices are in use to steady the plate while under the action of the hammer and chisel. The simplest of these, if the bench is substantial, is to screw down the plate by one of the corner holes, varying the angle and fixing by another screw, according to the requirements of the work. A second plan is to fix with screws two lengths of hard wood on the bench. A third plan is to procure a paving stone, say 24 in. by 16 in., well dressed on one side and left rough on the other; brush all dirt from the rough side and coat it with cement, which is made as described on p. 41, or of 2 parts by weight of Swedish pitch, 1 part of resin, and 4 parts of common whiting. Melt the pitch and resin in an iron pot; dry the whiting in an oven, and break up to a powder. Then stir in as much as will form a fairly thick cement while hot; make as much as can be poured out neatly without overrunning the stone. When this has been done, gather the pitch in the centre into a mound, warm the plate, and press down flat and solid. The block is used on the largest sandbag, and will be found very handy, as it prevents the plate from springing. The plate can be knocked off by placing a wide chisel under it and giving a smart blow with a hammer. To clean off the cement, it is rubbed with a tallow candle, warmed, and rubbed with a rag.

An experienced hand will now proceed, with a suitably sharpened chisel, to cut out the letterings as they are marked out, the chisel taking the whole width of the letter; but to outline with a lozenge chisel and then to take out the centre with a flat chisel is the easier way, though this, of course, takes longer. When the letters are roughly formed, the

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corners and other angles require special attention, and want cutting and recutting every way with a slightly set-off chisel until the corners are perfectly square. As to the depth of cut $\frac{1}{16}$ in. is ample, and the bottoms of the letters should be left rough and the edges slightly undercut, to give a better hold to the filling.

The beginner will outline the letters with a lozenge chisel, whetted at a rather acute angle, and set off at about 30°. Beginning with the perpendicular lines, outline them boldly as regards depth, holding the chisel slightly sideways, so as to undercut the letters. Undercutting makes the letter slightly larger at the bottom of the cut than at the surface, and therefore the letter holds the filling more securely. Having cut all the perpendicular lines in one direction, turn round the block and recut the same lines in the opposite direction; this will make the corner square. Then cut the cross lines in the same manner. The straight lines are more easily cut than the curved ones, so until the workman has obtained dexterity with the chisel the curved lines should be cut with the graver. The outlining being done, take a flat chisel nearly the width of the lettering, and proceed to cut the letters to the depth of one-sixteenth of an inch. Leave the bottom of the cut as rough as possible, so as to hold the filling better. With the scraper (Fig. 29, p. 35) remove the burr thrown up by the action of the chisel, and then with an ordinary graver with a wide facet square up the corners and give a graceful outline to the curves. Finally, thoroughly clean all the letters with turpentine applied with a rag. In cutting zinc name-plates, it will be found that the metal tends to clog the point of the graver. To keep the point of the graver clear, have screwed down to the bench a small flat piece of wood, pine, deal, or any soft wood, and in this dig the graver after each cut, so clearing the point from the zinc.

There are several compositions for filling the

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Fig. 101.—Engraving Name-plate.

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letters after they are engraved, and various ways of using them. For common black work, shoemakers' black heelball is used. This is powdered, placed in the engraved letters, and the plate made hot; or, instead, the heelball is rubbed into the hot plate, the superfluous filling being scraped off while hot. The old method is to fill the letters with best sealing-wax, either black or red, ground up in an iron mortar. The best wax should be obtained, and, failing the use of a mortar, the wax may be broken into convenient pieces, placed between two clean pieces of brass or iron plate, and the whole wrapped in several thicknesses of brown paper; the package is tied up with twine, and hammered well. This will make the wax quite small enough.

An alternative for best wax is the following composition: 4 oz. of pale shellac and 1¼ oz. of Venice turpentine are melted by a gentle heat, and, while hot, mix in (for red wax) 3 oz. of vermilion, or (for black) 3 oz. of ivory black and a little Prussian blue. Pour it upon a clean iron or other cold surface, and when cold powder it for use and keep it in a stoppered bottle. Have the plate quite clean, and fill all the cuts with the powdered wax, being careful not to get the wax all over the plate; with a camel-hair brush gather the wax in a little hillock above the surface of each cut to allow for sinking. Put the plate into a hot oven and watch it carefully, turning the plate frequently so as to heat it evenly all over. Do not let the wax bubble or boil, or it will contain air-holes. If the use of an oven is not convenient, stand the plate upon two bricks, and burn paper under it until the wax melts. Probably, also, the top of a modern gas cooking-stove would answer the purpose admirably. As soon as the wax begins to melt take out the plate from the oven, and press the wax into the cuts with a flat piece of metal. Any wax that may be smeared over the plate can be wiped off while the plate is

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hot, if it is not too close to the letters. The plate must now be left to cool gradually.

To remove the superfluous wax from the surface of the plate, the water of Ayr stone must be freely used with plenty of water. Rub the stone always in the same direction, lengthways being preferable. The utmost cleanliness must be observed, as any foreign matter rises to the surface, and the wax should be rubbed down till a clean and brilliant colour is obtained. The wax being removed, dress the plate with a piece of leather and crocus powder moistened with common oil. A final polish with a piece of soft chamois leather may be given; if the filling is black, use lampblack as a polishing medium with the leather; the finest rouge will answer in the case of a red filling; or the brass plate may be polished with metal-polishing paste.

Another method of filling is to use the black or red powdered wax ground up with gold size or mastic varnish; the letters are filled with this composition by means of a palette knife, and left to set quite hard and bright. The surface is cleaned with a little alcohol and a pointed rubber, a little bit being done at a time, drying off with a clean cloth, and finishing with metal-polishing paste.

A third method of filling letters is to use sealing-wax dissolved in alcohol to make a thick paste. When the alcohol is evaporated the mixture will harden, and then the plate can be finished as usual.

The method of fixing a name-plate will vary with its situation. Generally name-plates are fixed to mahogany or oak blocks, from 1 in. to 2 in. in thickness, with a quarter-round bevelled margin of from ½ in. to 1½ in. wide. For plates that are to be affixed to doors, etc., two screwed bolts are soft-soldered to the back of the plate before the filling is done. Corresponding holes are then bored through the block and also the door, the plate being secured in position by nuts inside the door.

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Where plates are to be exposed on a brick- or stone-fronted building, they may be screwed on to a block from the front, or secured by means of a slot and catch, so that the block and plate may be taken indoors at night; or, instead, the block may be fixed permanently.

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CHAPTER VIII.

ENGRAVING COFFIN-PLATES.

THE idea is general that coffin-plates are cut with the hammer and chisel, but such is not the case, the plates being too thin to be so treated. It is a mistake, also, to suppose that coffin-plate work and memorial brass-work are the same. The chisel is used on memorial brasses, which often are finished with the graver. In the rare case of the coffin-plate being of massive brass or silver, there can be no objection to the chisel and hammer being used, the lettering being afterwards filled with wax.

A coffin-plate engraver must hold himself in readiness to work at all times, Sundays included, and often there is but a very short time in which to do the work. For this latter reason the engraver must simplify the inscription as much as he possibly can, with the permission of the people most interested.

The coffin-plate engraver's work-bench or table should stand firmly, preferably under a window for day work, and under a convenient gas bracket with two or more joints for night work.

Two sand-bags will be found sufficient, one of 8 in. and one of 6 in. diameter; by their use the work is raised to a convenient height, and can be turned in any direction as may be necessary.

Coffin-plates may be bought at many good ironmongers' shops, in brass and metal, from 3 in. by 4 in. up to 16 in. by 16 in. in size. In shape they vary from the small square plate to the heraldic shield. The outlines between these extremes may be anything between a simple ellipse and a richly chased Louis XIV. shield. But as a rule the taste

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of the workman is not consulted, and he follows instructions merely.

The shape and style of the plate having been decided upon, it must be tacked down to a piece of deal board, the tacks passing through the small holes round the edge of the plate and the inscription may be set out on it. Avoiding scratches, find the centre of the plate with the large compasses, and strike lightly two semicircles at the top and two at the bottom of the plate, as in Fig. 102, and then rule with straight-edge lines each side of the centre the same width for the word "died." It will now be easy to rule the remaining lines at the proper distances, as required.

Probably it will be found an advantage to slightly smear the surface of the plate with grease, which will cause the plate to take the pencil marks more readily. Or, instead of setting out the lettering on the plate, direct, cut out a sheet of paper of the same size and shape, and draw a line down the centre and rule the double lines and strike the semicircular lines required for the inscription.

A central line from top to bottom of the plate will aid in balancing the letters. A good plan is to count the number of letters in each line, and commence at the central letter, finishing the remainder of the line to the right hand, and with the other half working back to the left hand; by this means an equal space is left at each end of the line.

If the inscription has been set out on paper, it will have to be transferred to the plate. Place on this a sheet of black transfer paper and the drawing on top, and carefully go over the inscription with a hard blacklead pencil, or with an ivory tracer having a smooth point. The inscription now is found to be transferred to the plate. Rule light pencil lines at the top and bottom of the letterings, and with the steel tracing point trace or scratch in over the black lines. If this pointing in is not done, in the course

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of the work the black transfer lines will be rubbed out. If it has not already been done, tack or screw down to a flat deal board the plate about to be engraved, to give greater ease in handling and to avoid bending it, as coffin-plates are very thin. If the plate is particularly thin, make a mould of wet tissue paper to fill up the entire cavity; this mould can

Fig. 102.—Coffin-plate.

soon be dried in an oven, when the plate may be screwed down to the board as before, and will be ready for outlining.

The proper shapes of the various styles of letters used in coffin-plate inscriptions can be soon learned by observation, and if a few specimens of type can be procured they will be of great assistance. There is plenty of variety to be obtained from the various

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styles of block, Roman, and italic letters, without having recourse to ornamental alphabets, which are out of character. The only other style admissible is the Old English, if it can be written properly. Fig. 102 shows some of the styles that may be employed; a variety of styles of lettering are shown in the companion "Work" Handbook, "How to Write Signs, Tickets, and Posters."

Brass coffin-plates are for the most part engraved in a superior manner, though not necessarily highly ornamental, as for instance a shaded block or Roman letter for the name, "Died" and "Aged" in old English, and the rest of the inscription to correspond with the headline, but in smaller characters (Fig. 103 gives the idea). The name should be prominent, and in the full-sized brass plates should always be in full on the same line. A headline can always be made longer by making the curve sharper. A long name may also be got in by slightly reducing the squareness of the letterings, that is by shortening the cross-bars. But the size of the plate and the length of the inscription must invariably regulate the setting out of the letters.

When the whole of the inscription has been roughly sketched, the pencil lines may be gone over more carefully with the steel point or etching needle (Fig. 28, p. 34), and then the actual engraving may begin. But before describing this process the tools for the work must be mentioned.

Of course, the engraver's usual tool outfit is necessary. The gravers required are the ordinary square graver, sharpened at a moderately acute angle, and a shading graver for thickening or shading the letters. If, through lack of time, the letters cannot be diagonally coloured (see p. 46) the insides of the letters may be wriggled with very good effect. For work that is flat (coffin-plates for instance) the graver is not required to be greatly set off, but the set off of a graver is especially useful when colouring

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and blacking out; "colouring" implies a series of horizontal, vertical, or diagonal lines cut close together, but leaving a plain surface between each

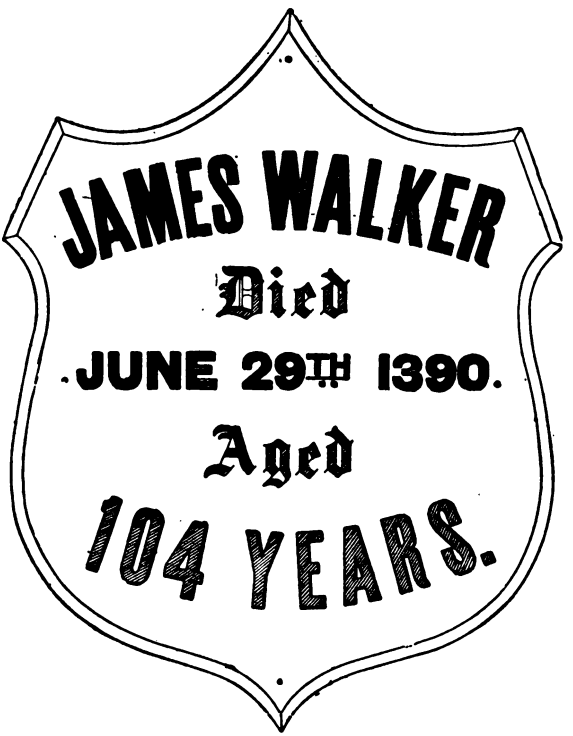

Fig. 103.—Coffin-plate.

line; in "blacking out" a number of cuts of the graver are made so close together as to cut away the entire surface of the metal. The set off enables the cut to be made to within a short distance of the boundary line, and then a sudden impulse forward is

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given to the graver to complete the cut up to the line without slipping past it. It is a good plan to have a graver suitable for every class of work likely to be done, as different classes of work need different tools; and if one or two tools only are used, and constantly whetted and re-whetted, a great loss of time is incurred, and the graver is gradually but surely wasted away.

To begin the actual engraving, set the board on which is fastened the plate on a couple of sandbags, say one of 8 in. and one of 6 in.; sit or stand well above the work, and then take the handle of the graver in the palm of the right hand, grasping it firmly with the thumb and forefinger (see p. 43), and cut all the outside outlines. Then, with the spring dividers set at the proper width and with one of the legs in the outside cut, rule the inside lines; by this means all the letters are made the same width, this being most convenient for block, Roman, and the shanks of Old English characters. In certain styles of characters the right side always is shaded or thickened at the time of outlining, by a succession of cuts side by side while the graver is in position. When the long or upright lines have been engraved, the right angles and curves are dealt with in the same way, and then coloured diagonally, blacked out, or wriggled with a flat tool of the same width as the letters. Colouring executed as described on p. 46 is the neatest, but takes the longest time. A carefully whetted graver at a more acute angle is required for this work.

Wriggling looks well, and is produced with a flat graver made by whetting the belly of the tool with a very slight set off, say 5°, and then sharpening it on the back the same as an ordinary graver. The effect is produced by pushing the tool along, keeping up a regular rocking motion from the wrist. Fig. 103 shows the result.

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Blacking out is done with a wide No. 10 or 12 shading graver, which may be used lengthways or across the letters, but not diagonally. When cutting across—the usual way—the cut should be taken from the outline cut towards the thickened cut, and much pressure must be brought to bear in order to plough the metal out in a clean cut. Shading gravers do not require to be whetted on the belly, that portion of the tool being already incised with very fine parallel lines. Being whetted on the back only, they produce a given number of lines on the metal after a cut is made, and when each cut is joined to the other skilfully a brilliant appearance is produced; they effect a great saving of time. Shading gravers are made in a variety of widths and gradation of thread, and are curved outward on the belly with the object of being used in a series of quick forward cuts, throwing off the chip from the cut at each stroke, by which means a great deal of surface may be quickly removed. Large surfaces of work blacked out with the shading graver may be relieved by cutting thereon a series of small bright dots or spots with a round-nosed graver. This and another pattern called the "brain" pattern, from its winding in-and-out movement, are used frequently. The round-nosed tool is formed by rounding off the sharp angle on the belly of a square graver and whetting the back, the same tool being used as a wriggler in forming the brain pattern.

The methods of engraving plates vary with the individuals. For instance, a brass stencil of "Born," "Died," and "Aged" may be carefully cut in Old English characters, and successively laid on the plate, each in its proper position, and traced on with the tracing point. Avoid scratching the polished plate, and it is advisable to wear a soft chamois leather stall on the thumb of the right hand while working with the graver on the plate. The tools also must be kept very keen, as a dull graver may be the

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cause of a serious slip, which it may be impossible to hide. In a large practice stencils of single letters may also be used, and grouped together in the required inscription. By the use of these, when two or three plates are wanted at the same time, an inscription may be traced on the plate in a few minutes.

A good method of quickly tracing inscriptions is to use white dry prints described on p. 50. Make the letters of uniform height, say, 1½ in. for the name, for "Born," "Died," and "Aged" in Old English, and 1 in. for the other letters and figures. On the completion of a plate, take a "dry print," as follows. Wet a sheet of good paper and lay it down on the plate, lay another sheet over this and rub all over with an ivory rubber until the paper has sunk into all the cuts; then take off the damp paper, and put aside to thoroughly dry. Cut out the letters squarely, with a little V-shaped nick at the top and bottom to show the centre of the letter, and put away in a box till the whole alphabets of block, Roman, and Old English and a set of figures have been collected. For using these prints, slightly grease the plate with oil applied on cotton wool, rule the required lines with a soft lead pencil, divide the lines into as many spaces as there are letters, dust the dry print with dry whiting tied up in a piece of well-washed linen. Lay the print in its place on the plate, letting the notch rest upon the line; rub the back of the print with the forefinger, and the letter will appear in white lines. Trace in each letter before another is laid down to avoid rubbing it out. In ornamental work these dry prints are most necessary where the design has to be repeated, and they are useful for reference in finishing the work. Ornamental work on coffin-plates should be used but sparingly, and only at the edges.

In one case an elaborate and highly ornamented coffin-plate was done entirely in plain Old English, the groundwork being enriched with a tasteful de-

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sign of scrollwork and flowers. The plate was afterwards silver-plated, the letterings burnished bright, and the ground left a dead white, forming an effective whole. This had a brilliant effect, and strange to say did not appear to be overdone.

But, as indicated above, if the introduction of ornamental work is at all permissible it should be confined to the edges of the plate, being sometimes a mere bright wriggled waved line, with short curved outshoots to the right and left of each wave respectively; such an ornament may give a neat finished appearance. A double line run round with a double wriggling tool, with a coarse line between done with a narrow flat tool, looks well. A border of fern fronds and sprays of maidenhair fern also has a pretty appearance. The stems of the ferns are wriggled with a narrow round-nosed tool, and the fronds formed with a narrow shading graver, graduating the cuts from base to summit. The maidenhair fern is formed with the shader in a series of cuts towards a common centre, making a kind of triangle; then light hair-lines are cut joining the spray together; a thick side cut with an ordinary graver is then taken into the middle of the leaf, and the top is serrated with four short side cuts to imitate the wavy outline of the natural leaf.

An ordinary full-size coffin-plate would be 15 in. by 11½ in., and if the shape shown by Fig. 103 is adopted there will be plenty of room for the inscription. In executing such a plate, first it is filled nearly to the edges with engraver's cement (see pp. 41 and 113), and while this is hardening the inscription may be set out on a sheet of paper, and transferred, either by the use of carbon paper or by rubbing the back of the paper all over with a soft black-lead pencil, on to a film of beeswax, rubbed over the plate before getting too cold. The wax serves to prevent the paper from moving while going over the letters—as it is very likely to do on a highly

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polished plate. The head and foot lines are 1½ in. block letters, shaded with a narrow shading graver. The name is wriggled with a No. 12 shader, while the bottom line is coloured diagonally with a graver slightly set off. "Died" and "Aged" are in shaded Old English characters, coloured diagonally, and the date is in 1 in. block letters coloured straight across. Novelty is not claimed for this arrangement, but it is legible and simple. It must be remembered, how-

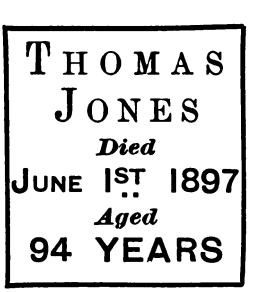

Fig. 104.

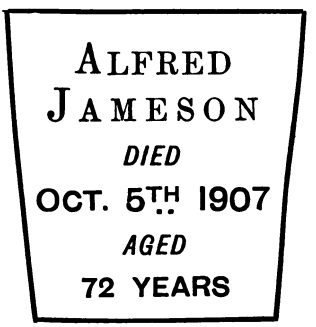

Fig 105.

Figs. 104 and 105.—Coffin-plates.

ever, that in different parts of the country different styles are in favour.

Figs. 104 to 106 show other shapes in which brass plates are commonly made. Fig. 104 is fairly well balanced.

Fig. 106 has the bottom line condensed so as to make it shorter than the one above. This shape should not be used unless the inscription is suited for it, as it would be impossible to properly arrange an inscription in which the Christian name is long and the surname short. It is necessary to exercise discretion in using this plate. Fig. 105 is a plate in which any inscription can be placed. That shown

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is a very good arrangement, but if it should happen that the inscription has two Christian names the top line should be in the form of a segment of a circle, as in Figs. 102 and 103, so as to give more room and improve the appearance. Plates shaped at Figs. 104 and 105 look very well if written in Old English, provided the letters are properly formed and that the inscription will admit of the lines being varied in length without either expanding or condensing the words too much. If this has to be done to any extent it is better to use some other style of lettering. When planning inscriptions, it should be borne in mind that the words "Born," "Died," and

Fig. 106.—Coffin-plate.

"Aged" should be kept small in size, prominence being given to the name. Many plates are spoiled through having their chief lines engraved in 1 in. letters, while what should have been only catch lines have been larger and, still worse, ornamented in an elaborate style.

The inscription, whether written or engraved, should in all cases be plain. If there is any ornament, it should be on the plate itself, forming, as it were, a border for the lettering.

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CHAPTER IX.

CHASING METALS.

CHASING, or embossing, though considered a branch of engraving, greatly resembles repoussé work, and so those who are proficient in that art will have little to learn in making an acquaintance with the art of chasing. Heraldic chasing is the art by which crests, coats of arms, monograms, and various kinds of ornaments, etc., are made in gold, silver, brass, or, indeed, in any of the ductile metals or alloys. This branch of the art presupposes some knowledge of heraldry.

The tools employed are of the same nature as are used for repoussé work, but generally of a finer make, subjects chased being, as a rule, more elaborate in detail and more highly finished than works in repoussé.

The tools, materials, and implements used in chasing metals are somewhat numerous and costly. It is, however, possible to start with only a few tools —say, half a dozen punches, a chaser's medium-sized hammer, a tracing point or etching needle, and a pencil. The chaser's hammer has a light double-ended head and a thin springy handle. Other requirements are carbon paper, a sheet of soft brass, a cement bowl, ladle, pliers, shears, 5 lb. of chasers' pitch, and a sandbag of from 10 in. to 12 in. in diameter. Flat work is fixed to a small paving-stone with chasers' pitch; sometimes a heavy block of oak is used, but a stone is considered preferable on account of its extra weight, as most flat work has to remain steady by its own weight under the hammer and punch. A beginner's outfit may be purchased for from 20s. to 50s.

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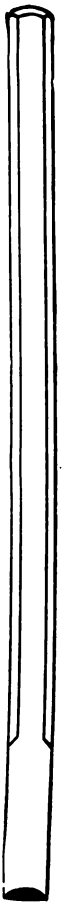

Fig. 107.

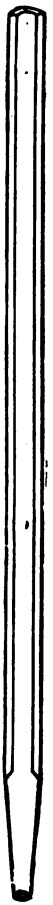

Fig. 108.

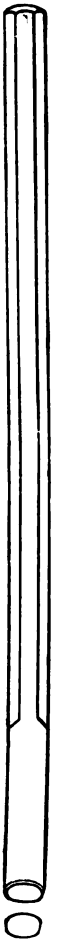

Fig. 109.

Fig. 107.—Tracing Punch or Tracer; Fig. 108.—Matting Punch; Fig. 109.—Relief Punch or Beater.

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As regards the punches, these are of many shapes. Fig. 107 shows a tracer or tracing punch as used in repoussé work; two of these will be required, Nos. 1 and 2, $\frac{1}{4}$ in. and $\frac{1}{8}$ in. respectively. These tools should be flat on one side and rounded on the other, the edges being formed by grinding down the round side; by their aid the outline curves and straight lines may be traced with equal ease, and some degree of relief can be obtained by their use. Two straight tracers (Nos. 3 and 4), $\frac{3}{16}$ in. and $\frac{1}{8}$ in. respectively, also will be required, ground on both sides; these tools should be rather sharp, but smooth at the edge; another $\frac{1}{8}$ in. tracer is required, and this should be quite sharp.

Tracing punches, when straight, are of various lengths and widths, and, when curved, they form segments of circles of various radii. Planishing punches resemble tracers, but are of different widths and contours; they are used for smoothing surfaces. The tracers and planishers should have their faces kept bright by occasionally rubbing them on a leather buff, which may be nailed to the bench.

Matting punches (Fig. 108) are of various degrees of fineness, and are made in a variety of shapes—round, square, oblong, and triangular. They are used for filling in ground-work, shading and finishing floral and other ornamental designs. Ornamental punches made to strike in at one blow a given portion of an ornament are also used in great variety, as also are punches for raising the surfaces of flat work, which is afterwards finished from the front. A relief punch or beater is shown by Fig. 109.

For supporting small articles a round-bottomed cast-iron cement bowl is used, filled with pitch brought to a blunt cone whereon the piece to be chased is fixed and left to set. The bowl in use is set in a collar on top of the sandbag, in which it can be turned in any direction (see Fig. 110). To

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keep the bowl steady under the hammer blows an endless rope is looped over it, and down through two holes cut through the bench, the rope hanging directly central, and forming a stirrup in which the chaser places his foot. Shaped articles, such as tea-pots and coffee-pots, are thus held in position.

The chaser's snarling-iron (Fig. 111) consists of a rod of steel about ⅜ in. diameter, turned up at one end, and turned down at the other in the opposite direction. One end is squared to

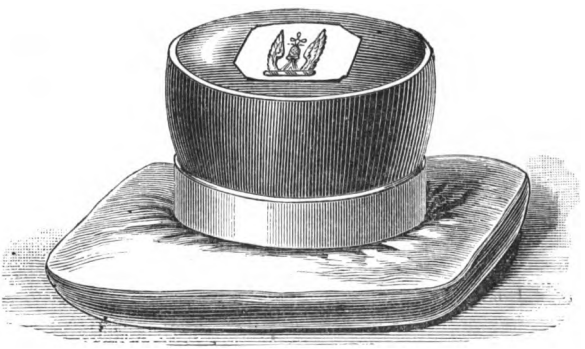

Fig. 110.—Cement Bowl on Sandbag.

fit tightly in the vice-jaws, where it is used always, while the other end has a rounded-off top. In use the snarler is placed in a vice, the shank being of such a length—say 8 in.—that it will take in all ordinary work; then the vessel about to be raised is pushed forward until the end of the snarler comes directly under the portion of ornament to be raised. A succession of smart blows with a hammer are struck on the shank of the snarling-iron, the vibration being communicated to the part in contact with the end of the iron, the metal thus being raised without, however, materially altering

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the shape of the article; this rough raising afterwards is finished from the outside with tracing, matting, or other ornamental punches.

The roasting-out apparatus used in chasing is a disc of sheet iron suspended by wires from a centre. The interior of the disc is cut out to admit the narrowest diameter of the vessel about to be emptied of cement. The vessel, inverted, is put into the disc, and the ends of the wires are brought to a centre

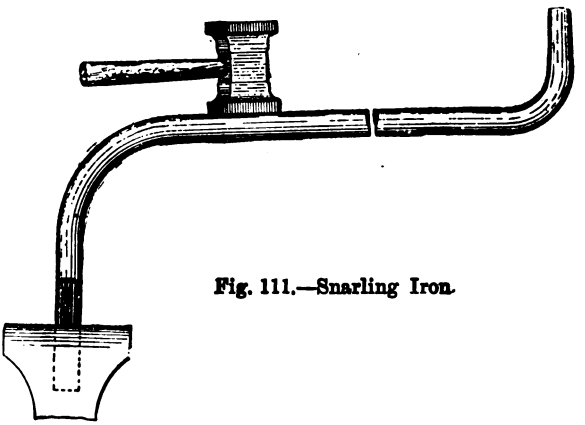

Fig. 111.—Snarling Iron.

above and lapped together with binding wire and attached to a dozen or so strands of worsted, which, in turn, are suspended to an iron spike driven into the wall some feet above the centre of the fireplace. This simple device is made to revolve near the fire, and as the vessel becomes gradually heated the cement melts and falls into a shallow iron pan underneath. Before roasting out the articles are painted over with a solution of common whiting and water, and when emptied are cleaned with a stiff brush.

The above tools, with compasses, dividers, and the usual requirements for sketching, almost complete the list. One other tool, however—the per-

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forating punch, or point—comes into use in connection with every pattern that has to be repeated. A pencil rubbing is taken of the pattern, and the perforator is used with the hammer to prick through the pattern which has to be repeated. A thick sheet of lead is used on which to prick the pattern, so that the holes are as nearly as possible of the same size, and the pattern is reproduced on another article by laying down the pricked-through paper and lightly dusting with a pounce-bag filled with dry whiting; afterwards the design is marked in with an ordinary tracing point.

One class of chasing takes the form of ornamental and floral design raised from the surface of the metal, without, however, altering the form or contour of the article. The design on an article of hollow ware is sketched with a lead pencil, first brushing on whiting and water, in order that the pencil marks may show to advantage. If the design is repeated in a series of sections—two, four, six, or more—the divisions are stepped out with the dividers, and pencil lines drawn to indicate them. The portions intended to be raised are snarled up by means of the snarling-iron, the article being held in the left hand exactly under the part to be embossed, smart blows being struck with the hammer on the shank of the snarler, the rebound of which causes the metal to be forced upward (see p. 133). The article then is filled with chasers' pitch, and when set the ornament is scratched in with the tracing point, and outlined with tracing punches.

For curved and straight lines curved and straight punches are used respectively. Shading the ornament is sometimes done with tracers in a series of lines struck closely together, but more often with matting punches, which give a better effect when the work is electro-plated and finished. Planishing, ringing, and dotting punches of various sizes and shapes are used in finishing the ornament, and the

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curved tracers may also be used for striking either to the right or to the left.

In fluting, a branch of the chaser's art, the article is divided into as many sections as there are to be flutes, and marked in with a lead pencil. It is snarled up to the height to which the fluting is eventually to appear, the vessel being then filled with pitch and left to cool. The punches for fluting are hollow planishers, the dividing line of the flute being struck in with a blunt straight or curved punch, as the case may be. The rounded surface of a full flute is carefully finished with slightly hollowed planishers. In the practice of hollow fluting, in which the flute is sunk, in contradistinction to the full or rounded flute, the process is nearly reversed, and, with the exception of the snarling-iron, the hollow fluting is entirely worked in with rounded planishers. For cheap work, however, fluting, both hollow and raised, is accomplished in a powerful hand fly-press, furnished with press tools cut to the contour of the article to be fluted.

Chasing is also employed in repairing or touching up defective castings in silver and German silver. An efficient chaser often attempts figure chasing, that is, finishing castings of the human and animal forms. Ordinary tools are not often used in figure work, their place being taken by small files and "rifflers," or bent files, made in a great variety of shapes and angles to meet the demands of the intricate work.

Heraldic chasing is quite a distinct branch of chasing, and its scope is defined on p. 130. A common job for the heraldic chaser is to make harness crests. The materials for this work are flour emery and crocus powder, soft rags or cotton waste, sweet oil, steel wire scratch brush and sheet of carbon transfer paper, an H.B. pencil, several small files of various shapes, a small soldering bit, some soft solder and killed spirit, a cylindrical block

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of hard wood, say about 6 in. or 8 in. in diameter, and the same length—a piece of this size cut from a beech bough will suit admirably if the faces are parallel and made tolerably smooth—some $\frac{5}{8}$ in. cut tacks, a fine bradawl, and lastly the material to be worked upon; this must be thin sheet metal, brass or silver. For the present purpose No. 25 gauge brass is best.

Fig. 112.

Fig. 113.

Figs. 112 and 113.—Face View and Section of Harness Crest.

The harness crest shown by Fig. 112 represents a falcon's wings with hooded head, and is simple and easily executed.

There are two methods by which crests may be cut out; one of them is very simple and perhaps more suitable for beginners, but is not so satisfactory in its results as the second and more complicated method described below, which, however, is the one used professionally.

The first method of cutting out the crest is as follows. Cut a piece of brass about 3 in. by 5 in., or sufficient for two crests, and, having made the

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metal quite flat, cleanse and polish it on both sides, using first emery and then crocus. Wash it well in hot soda water with soap to remove all grease, and rinse clean and dry. Scratch-brush or emery-paper the back all over, or well scrape the surface, so as to prepare it to receive the solder, which is to be run into the reverse side of the crests. Lay the brass upon the wooden block, rough side down, and with the bradawl make a row of holes all round about 1 inch apart and ¼ inch from the edge; and tack the metal securely down through these holes.

The design of the crest drawn on paper may now be transferred to the brass by means of carbon paper and a hard pencil. Two transfers will be required. To avoid smudging the lines, sprinkle French chalk upon the brass and rub it gently over the drawing. In the case of the present example the transfer may be made direct, but in dealing with crests, monograms, etc., which would be reversed by transferring, it will be necessary to prepare a negative design. The simplest way of doing this is to place a piece of carbon paper upon a hard, smooth surface, lay the design upon it, and go over the drawing with a hard pencil; then a facsimile will appear on the wrong side of the design, and this may then be transferred to the metal.

To cut out the crests, take tracing punch No. 1 or No. 2 in the left hand and hammer in the right, and proceed to indent lightly the outline of the design, leaving out such markings as feathers, crossbars on the hood, etc., and keeping the flat side of the tool next the design; use a No. 1 tracer for all the straighter lines, and No. 2 for the smaller curves. When the whole of the outline is thus indented, go over it again, more deeply this time, repeating the operation till all the lines are indented evenly and as deeply as possible, arriving at this result by the frequent rather than the violent application of the tracer.

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Having outlined both of the crests, punch down the brass immediately surrounding the design with a No. 5 matting punch, as this will raise the figure in higher relief, and also render easier the after process of cutting out. Then with a No. 6 tracer cut through the whole outline as already traced. This process requires care, not striking too heavily, but with just sufficient force to go through the brass. It may be necessary to use sharp tools of different sizes and shapes, modifications of the No. 6 tracer, in cutting out, as outlines always must be as clear as possible. The crest may be cut out with a fine fret saw, if desired.

The above method is easy, but does not provide for properly shaping the subject. All depends on the fact that the untouched brass within the outline has become bulged up by the process of tracing and the use of the matting tool, and the form is dependent on the after chasing, which in some simple cases may answer well enough; but if the work is to possess real artistic merit a method must be resorted to by which the subject can be modelled, leaving nothing for the after chasing but details, such as the feather markings in Fig. 112.

Instead of the wooden block, the cement bowl is used. The pitch, which is a mixture of pitch, resin, tallow, and plaster-of-paris or sand, is melted and poured into the bowl until it just overflows, and when almost cold the brass should be heated, the unscratched or right side rubbed lightly with oil or tallow, and placed next the pitch, pressing gently, so that it shall sink sufficiently to make sure of it adhering to the pitch (Fig. 110). The corners of the brass may be turned down with advantage, for further security. When the pitch is almost cold, the design may be transferred as above, and the metal is ready to be punched down as in repoussé work. The brass is turned and the crest will be found correctly shaped, and there will be a much better subject for chasing

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than could possibly be obtained by the first method. The tools used in this work will be oval and oblong relief punches or beaters Nos. 7, 8, and 9. Using No. 7, the broader portions of the design should be punched down, at first all over to an equal depth; when by repeated applications the desired degree of relief is obtained the details of form are attended to; in this exercise (Fig. 112) the details are the pinions.

Crests must be beaten down to a greater depth than that necessary to give correct form. Fig. 113, p. 137, is a section of the crest taken across the centre, and will serve to explain what is meant; from Fig. 113 the depth of relief necessary may be compared with that sufficient in ordinary repoussé work; the line, A B, represents the level of the metal for crests, whilst the dotted line, C D, indicates the relief as in repoussé work. If this is not attended to the crests will be much too thin, whilst if the above directions are followed they will stand out well upon the harness and be most effective. For beating down the crest wreath use a No. 8 punch, and for the cord by which the hood is held use a No. 9; both these tools will be brought into use for the sharper portions of the wing, feathers, etc.

When both of the crests have been treated as above the brass should be removed from the pitch, cleaned, and washed in hot soda water with soap.

Cut out the crests with a fret saw; or, instead, place the metal face upwards upon a block of lead, and cut out with tracers, in either case taking great care to preserve the correct outline of the design. Whether the first or second method of preparing the crests has been followed, from this point the processes are the same in each case.

The cut-out crests are placed face down and their backs are coated with killed spirit (spirits of salts in which as much zinc as possible is dissolved); with a hot soldering bit run in solder until the crests are just full, but it must not overflow and adhere to the

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right side of the articles; guard against the solder adhering where it is not desired by coating with a mixture of blacklead and beer. There are now two solid crests, having edges rough and jagged, and these are filed clear and sharp with small files shaped to suit the intricacies of the work.

For the actual chasing of the crest, it is placed upon a cylindrical wooden block about 10 in. in diameter and 6 in. deep, supported by a sandbag. Place the original design so as to be easily seen, and indent all the lines exactly as they appear in it, using those tracers which more particularly suit the different lines, curves, etc., taking great care to follow the drawing faithfully.

A crest, cut out and chased, must be provided with some means of attaching to the harness. Short pieces of copper wire are soldered to the back in several places, so as to ensure that the crests shall be held quite flat and secure. Take a piece of ordinary bell wire, and, having stretched it straight, brighten it with fine emery cloth; dip the end of the wire in killed spirit, and holding it at right angles to the part of the crest where it is to be fixed, apply the point of a hot soldering bit to the solder with which the crest is filled; as the solder melts the wire sinks down to the brass, being held firmly so until cold.

With wire nippers cut the wire, leaving about ¼ in. projecting from the solder, and repeat operations until a sufficient number of wires are fixed; in this case five wires in each crest will be required, one at the point and base of each wing, and one in the lure; the lure is the line or leash shown at the bottom of Fig. 112. See that these wires are at right angles to the back of the crest, and of equal length; place the crest in position upon the harness, give it a slight pressure, so that the points of the wires mark the leather, and then with an awl pierce holes in the leather, insert the wires, press home, and clinch securely underneath the leather.

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CHAPTER X.

ETCHING METALS.

ALL processes of etching metal by corrosion depend on the coating of the metal with a resist, which is scraped away from certain portions, which then are etched or bitten into by chemical action. Etching is a process of ornamenting the blades of razors, cutlery, and of highly polished surfaces of hardware generally, which, although extremely simple, and now generally understood, was for a long time kept a secret, and which, from the effect it is capable of producing in good hands, deserves to be regarded as one of the fine arts. The two metals chiefly etched are steel and copper, but it must be remembered that the process is applicable to all metals, provided the proper acid in each case is used.

Briefly, the process of etching is as follows: the metal is coated with the resist or etching ground (see below), and this is allowed to become cold and hard, and is then drawn on with needles, made, preferably, of a stick of steel of $\frac{3}{8}$-in. diameter, round or square section, tapering to a fine point at each end; the special tool for the purpose is the etching needle, illustrated by Fig. 28, p. 34. The weight of the steel tool is sufficient to penetrate and bare the metal of resist as it is drawn along, leaving the hand more at liberty to draw freely or form letters as the case may be. If the metal is in the form of a plate, it now has a wall of wax built around its edges, and into the shallow dish thus formed the etching acid is poured. Knife blades and similar small articles, having been properly coated with resist, may be dipped into the acid or the latter may be applied to the portions to

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be etched by means of a camel-hair pencil or a stick, at the end of which is mounted a little ball of tissue-paper. Remember that all portions not covered with the resist will be etched. When the acid has bitten sufficiently, pour it off, remove the resist, and wash thoroughly in clean water. If it is required to etch more deeply certain portions, cover up the rest with an etching ground of lampblack and Venice turpentine, or with any suitable etching ground, and apply the acid again. When the etching is complete, wash off every trace of the acid, and clean off the ground with spirit of turpentine or paraffin oil.

The resist or etching ground is made by melting together in an earthenware vessel over a slow fire black pitch, white wax, Burgundy pitch, asphaltum, and gum mastic. Other etching grounds are (1) asphaltum varnish; (2) yellow beeswax dissolved in turpentine and continuously decanted until sediment does not remain; to 6 parts by volume of this add 1 part of japan varnish; (3) asphaltum, Burgundy pitch, and beeswax melted together; (4) japan black. Resists that are too thick to be applied just as they are may either be melted and then brushed on, or the steel may be warmed so that on rubbing it with the resist the latter will melt and leave a thin film.

The greatest care must be taken that all parts to be left plain are well covered with the resist. When the acid is in a boiling state, the bursting of the bubbles produce a kind of spray, which discolours any unprotected part it may happen to fall on. Or the article being etched may be knocked over accidentally, when the acid may run down the sides, and play havoc if the metal is not protected. The etching ground must not be worked on whilst it is tacky. It should work clean and sharp, and the parts to be etched should be as clear of ground as possible.

Another way to lay the ground is as follows: Clean the prepared plate with turpentine and whiting, removing the whiting with bread. Wrap a ball

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of ground in new taffetas silk, and place the ball on the plate. Fasten a hand-vice to the corner of the plate, inserting a piece of cardboard to prevent it from damaging the surface. In a room where there is no dust, heat the plate over a gas or other flame until the ground melts through the silk and spreads evenly over the plate. While the plate is hot, with a dabber, which is a cotton-wool pad enclosed in a silk cover, dab the ground all over to spread it evenly, cleaning the dabber when it gets full on a piece of coarse canvas. If there is not ground enough, add a little from the ball and dab again. Next comes the "smoking" of the plate. Twist together two or three wax tapers; light them and pass the flame rapidly along the surface of the plate, taking care not to burn the ground, but coating the ground with soot. The plate is now ready for the needle.

The etching acid for copper, steel, etc., may be any of the following mixtures: (1) Pyroligneous acid, nitric acid, and water; (2) diluted nitrous acid; (3) 2 oz. of copper sulphate, ½ oz. of alum, ½ oz. of salt, ½ pint of vinegar, and 40 drops of nitric acid; (4) 4 parts of glacial acetic acid and 1 part of absolute alcohol; allow to remain for thirty minutes, and add gradually 1 part of nitric acid; (5) 1 part of fuming hydrochloric acid and 7 parts of water; add boiling solution of potassium chlorate and dilute with water. Nitric acid diluted may be used alone, and will be found to attack almost all metals, gold and platinum being exceptions; but it is not a nice acid to use, staining the hands, and, besides, very noxious fumes arise from it.

The strength of the etching acid is important. It is better to have the acid a little weak and take a little longer time to do its work than have it so strong that it quickly spoils the work.

According to Prof. Namias, a good etching acid is a mixture of a 1 per cent. solution of sulphuric

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acid with a 5 per cent. solution of persulphate of ammonia; this is said to dissolve zinc and aluminium without liberating hydrogen. Copper is attacked slightly by a neutral solution of persulphate of ammonium, and very strongly when free ammonia is added to the sulphate.

A common substance which can be used very successfully for etching names on steel tools, etc., is sulphate of copper; this is common bluestone, which can be obtained from any druggist; a pennyworth will do a good deal of work. The way to use it is to crush a small quantity of the blue crystal into powder, and then add to it a very small pinch of table salt, and moisten it with a little water; then, having written the name through a suitable ground—soap answers very well for this rough and ready method—drop the etching material on to the writing, and let it stand for two or three minutes. Of course, the longer the material is left, the deeper is the etching. When many names are to be etched, make a solution by crushing some bluestone crystals into powder, putting this into a small bottle with a little salt, adding hot water, and then shaking until all is dissolved. It is best to keep adding the powdered crystals until the water will dissolve no more; by this means the strongest saturated solution will be obtained, and, kept corked, this will keep its strength for months. In using this for etching designs it would be advisable to make a ridge of soap outside of the design, so as to keep the liquid from running off on to other parts. The above process answers for workshop tools.

For applying etching acid, use a small sponge attached to a piece of wood the size of a camel's-hair brush—a brush handle would do—and cover the wood with acid-resisting black.

A typical job is to etch a name on a chisel; the tool must be clean, and it may be made so by rubbing bright with fine emery cloth. For laying on the

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ground tip the bottle containing the resist, which may be japan black, and, placing the finger over the opening, obtain a small quantity. Now spread the black backward and forward all over the surface of the steel tool, keeping it as even as possible, and be on the look-out for bright streaks, which sometimes occur when a bit of grit has mingled with the black. Do not have the resist too thin for a start, and apply a second coat if the first is not thick enough; but this must be done quickly, for it dries very rapidly. For a beginner it is better to have the resist too thick than too thin; and a few trials will soon show the right consistency. If the resist is not a liquid, it may be applied by one of the methods mentioned on p. 143.

Having applied the ground, put the chisel aside, and let it remain for about twenty-four hours; if two or three articles are to be etched, they might all be coated in quick succession and then put away; this method saves time. The ground being firm and yet not brittle, with the aid of an etching needle draw upon its surface and so expose the steel.

Names on tools may be in ordinary script, or Old English characters might be attempted, as a certain amount of elasticity may be exercised in their construction without altering their general appearance. Block letters also look well, though a little care is necessary to give them a nice, upright, square appearance.

For nice, smooth work, the point need not be very sharp; the object is not to scratch the metal, but simply to remove the ground, exposing the steel so that the acid may act freely upon it. To brush away the detached ground, a camel's-hair brush or something stiffer may be used. There is no need to fear using it, as the ground will stand a moderate amount of rough usage. Note carefully whether any bits of ground require dislodging from the lines of the name or design. Some may have been neglected, and these appear as a bright spot after

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biting, as a result of the action of the acid being retarded.

Biting in is the next process: lay the chisel with its blade level, and pour a few drops of etching acid (see p. 144) on the letters, and spread well over with the sponge stick mentioned on p. 145, taking care not to allow the acid to go beyond the ground. At once the bright surface of the steel turns black, and bubbles will rise to the surface of the acid, and burst incessantly. This will continue for a few minutes, after which the acid will become thick and turbid. Now remove the acid with a sponge, swilling this in clean water at once. About two of these bitings will be sufficient for ordinary work; but the number may be increased should the letters be required very deep. But it is well to remember that the more the letters are exposed to the acid, the coarser they are liable to get, for the following reason: The acid, having eaten to a certain depth, will undermine the edges of the letters, and eat away the metal under the ground; and, though scarcely perceptible in most instances, at times, if the biting is overdone, the letters will appear very much coarser than desired.

The etching being complete, remove the ground with spirit of turpentine or paraffin, and the letters should appear of a nice, dark colour, clear and sharp; but, if the etching has been on iron, the letters will be bright.

Fig. 114 represents some letters on part of a tool the dark part showing the etching ground laid on as it should be before applying the acid. When the etching is completed and the ground washed off, a reversion of the effect illustrated will be the result, the light parts in Fig. 114 being dark, and the dark parts bright.

Another method is to leave the characters in relief, with the surrounding parts corroded away to a limited distance; this should embody some kind

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of ornamentation. The design in this instance, when etched, stands out in bold relief, and presents a striking contrast to the corroded surrounding metal. Persons handy with the brush, the manipulation of which is the principal part of the process, may prefer this method. The process will be readily understood by those who have attempted the previous method. The letters or design is coated thickly with japan black applied with a fine brush. Then enclose the border with etching ground, and when thoroughly dry, bite away the exposed metal with acid. If the work is to be artistic, a weak bite only with the acid will suffice. This method may be applied in various ways. Scrolls of ornate work look

Fig. 114.—Etching in Relief.

very effective when treated in this manner, and plenty of articles, such as cutlery, scissors, etc., may be always found to work upon. For etching to a moderate depth in this manner will necessitate ample use of acid, as much more metal is to be corroded than in the previous method.

Some difficulty may be met when etching on anything having a convex surface, but the method shown in section by Fig. 115 overcomes all difficulty. After putting on the ground and marking the letters, put a border round them with some plastic acid-resisting substance, such as wax or tallow, the border being deep enough to hold the requisite quantity of acid without running over the sides. Sometimes when the acid is poured on it will show a leak in the border, and this must be stopped at once. It is neces-

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sary to cover the article with ground freely, not confining it merely to the place where the etching is done, but spreading it where it may act as a protection in the event of any acid spreading.

In etching round articles, some tools, for instance, where the diameter is very small, the above method of backing up the acid with tallow is unnecessary. The tools should be coated with ground all round, and the acid applied when the part to be etched is in an inverted position. The attraction of the metal will be found quite sufficient to retain enough acid to etch with. This mode requires a little attention during the process of biting

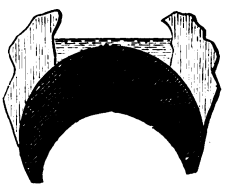

Fig. 115.—Etching on Convex Surface.

in, when the characters are rather large in proportion to the circumference of the article, because only part of the characters can be etched properly at one time, and the tool or other article has to be tilted occasionally for the acid to flow to other parts. This will entail a little patience on the part of the operator, who, if he is not very particular, can fix the article in a vice or place it on two supports, and look after it just occasionally.

For etching a club shield, the usual materials will be required, and in addition a good, fine-pointed camel's-hair brush and a small saucer. The shield, it is understood, has already been made, and the surface prepared. Begin by melting enough paraffin wax in the saucer to form a layer about the same thickness as the shield, which must now be placed

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face upwards in the wax, and the whole set by to cool. Be careful not to allow any of the wax to overrun the surface of the shield, as it would be detrimental to the adhering of the Brunswick black or other of the grounds. The style in which the inscription is to be etched must now be decided upon. Individual preference must, of course, be the leading factor in this selection. However, it is to be remembered that, as in former processes mentioned in this chapter, in any style chosen, the letters, etc., that are to appear raised must be coated with Brunswick black or other suitable ground already mentioned, so as to protect the parts thus covered from the action of the etching acid, which is free to attack the parts that are to be sunk. Fig. 116 represents a shield already etched, this being exactly the reverse of the shield when coated with ground.

The shield, having been coated with black forming the required design, should be allowed to dry for at least five hours. The Brunswick black will then be sufficiently hard for all irregularities (if any) in the shape of the letters to be removed with an etching needle (Fig. 28, p. 34) or with a steel stylus, which can be made from a needle, from the point of which has been broken off about ¼ in., and the end smoothed and rounded on an oilstone. The retouching having been done satisfactorily, pour enough water into the saucer to just cover the shield, and add nitric acid until minute bubbles are seen to rise from the exposed parts. Sufficient acid has now been added, and the most important part of the process commenced.

The work must be constantly watched all the time it is under the action of the acid, as possibly a corner of a letter or a hair line may peel. Should this occur, the acid must immediately be poured off, and the surface of the shield gently dried with blotting-paper, the missing portions repainted, and the work submitted to the acid again. But this ought

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not to happen if the shield is perfectly clean before applying the ground and if the latter is allowed to dry thoroughly. Half an hour will be quite long enough to etch a shield made of German silver, which, by the way, is the best metal for the purpose.

The etching done, pour off the acid and well rinse both saucer and shield in water. Dig the shield from its bed in the wax, and dry, and then soak in turps to remove all black, and dry again. A small piece of the very best black sealing wax must now be procured; make the shield just hot enough to melt the wax, and rub the latter into the etched

Fig. 116.

Fig. 117.

Figs. 116 and 117.—Etched Club Shields.

parts. When the shield is cool, remove superfluous wax by rubbing it in plenty of water with a very fine piece of pumice-stone, or, better still, with water of Ayr stone. Dry this time in sawdust. To finish the shield, drill three small holes in the corners for attaching it to a cap; chamfer and burnish the edges and polish the front, and finally give the whole a coat of colourless lacquer. Fig. 117 shows another finished shield etched in the above manner.

All the foregoing processes, owing to the length of time required for their completion, and the difficulty of obtaining two or more subjects exactly alike, have been found to be entirely useless for adoption by etchers in the Sheffield cutlery trades;

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therefore exhaustive experiments, conducted by different etchers, have been made, and these have led to speed in manipulation, exactness of design in regard to numbers, and cheapness of execution.

The etcher, who sometimes is also a copper-plate engraver, first engraves the subject on a brass or copper plate; a dozen or so impressions of this are pulled in a copper-plate press and transferred in regular order to a steel plate, previously prepared by grinding and polishing. This steel plate is etched rather deeply, so that the letterings or other matter will hold plenty of ink. The proofs are pulled in the press by a girl, who hands the wet proofs to another girl, who quickly cuts them out with a pair of scissors to a shape approximating that of the article, and lays an impression on a knife blade; then the knife is passed to another girl, who works at a light padded hand-press, in which the paper impression is pressed down firmly in order to leave the ink on the steel blade. Then the knife is passed on to have the paper removed. Then another takes the knife in hand, and coats it with a clear varnish. Another worker extracts the ink impression from the varnish with turpentine and a little cotton wool; and next, the etcher, with a stick, upon the end of which is mounted a small ball of tissue-paper, dipped from time to time in the acid, proceeds to etch in the subject until it is bitten deeply enough. The acid is then washed off in water, the blade dried, and the varnish cleaned off, paraffin oil being the cheapest and the usual agent.

The ink used for printing down the subject contains a certain amount of mixture of a greasy nature, so that the varnish, when passed over the steel blade, will not touch the greasy inscription; therefore, with a light hand and a little care the operator is enabled to extract all the greasy letterings without removing the varnish, and thus leave bare all the portions of the work intended to be attacked by the

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acid. Each individual etcher employs those inks and acid solutions which, in his experience, are most suitable to the work in hand. The above process is applicable to many tools, and is the one employed for saw-blades.

In regard to the etching of steel measures of length, an improvement is said to have taken place, the process of which is briefly as follows: A carefully cut stencil plate of copper is first made. The rule blank is coated with a quick-drying varnish, and before the varnish has quite set the stencil plate is laid thereon, and with a stiff brush the surface of the stencil is vigorously brushed, the brush removing in its course those portions of the varnish through the cuts of the stencil, thus laying bare the parts to be etched. The remainder of the process, the actual etching and finishing, is the same as for ordinary goods.

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